

VOL. 172, NO. 4



OCTOBER 1987

# NATIONAL GEOGRAPHIC

## WOMEN OF ARABIA 423

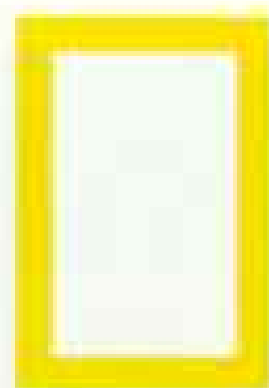
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**T**OSS A PEBBLE into a pond, and rings of ripples immediately attest to its impact, but when we launch an article into our sea of 40 million readers, we can't always be there to see the effect. Thanks to a letter from Canadian Prime Minister Brian Mulroney, we had a quick and authoritative reading on the impact of our July 1987 article "Canada's Queen Charlotte Islands, Homeland of the Haida."

*"I am sure it will interest you to know that, on July 11, I joined the Premier of British Columbia,*



*William Vander Zalm, to sign a Memorandum of Understanding for the establishment of a national park and a national marine park in the South Moresby area of the Queen Charlotte Islands.*

*"Your story's description in words and pictures of this cultural and ecological treasure was remarkable both for its content and timing. It illuminated wonderfully the value of preserving this area for future generations. As well, it demonstrated the deep interest the international*

*community shared with Canadians in bringing this matter to a successful resolution. Of the many voices raised in support of South Moresby, few spoke as eloquently and none reached as wide an audience as National Geographic."*

The "matter" was a 13-year bare-knuckle battle between logging interests and a partnership of Indians and environmentalists over preserving—or exploiting—a piece of the amazing archipelago. From 1,000-year-old trees to unique aquatic life, it is virtually a northern Galápagos in ecological importance. To the Haida the area is precious as a source and repository of their art and culture.

The partnership has won. Many feel our article played an important part in the resolution of this old controversy. British Columbia-born writer Moira Johnston and photographer Dewitt Jones were among those honored at a Haida potlatch that served salmon, halibut, octopus, and scallops to 1,200 celebrators. In time the few logging jobs lost will be more than replaced by income from the many visitors who will come to enjoy the islands and Canada's first marine park.

*Wilbur E. Garrett*

EDITOR

## Women of Arabia

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*Caught up in modernization, Saudi Arabia's culture still sequesters the lives of its women, according to an American who has lived there, Marianne Alireza. Photographs by Jodi Cobb.*

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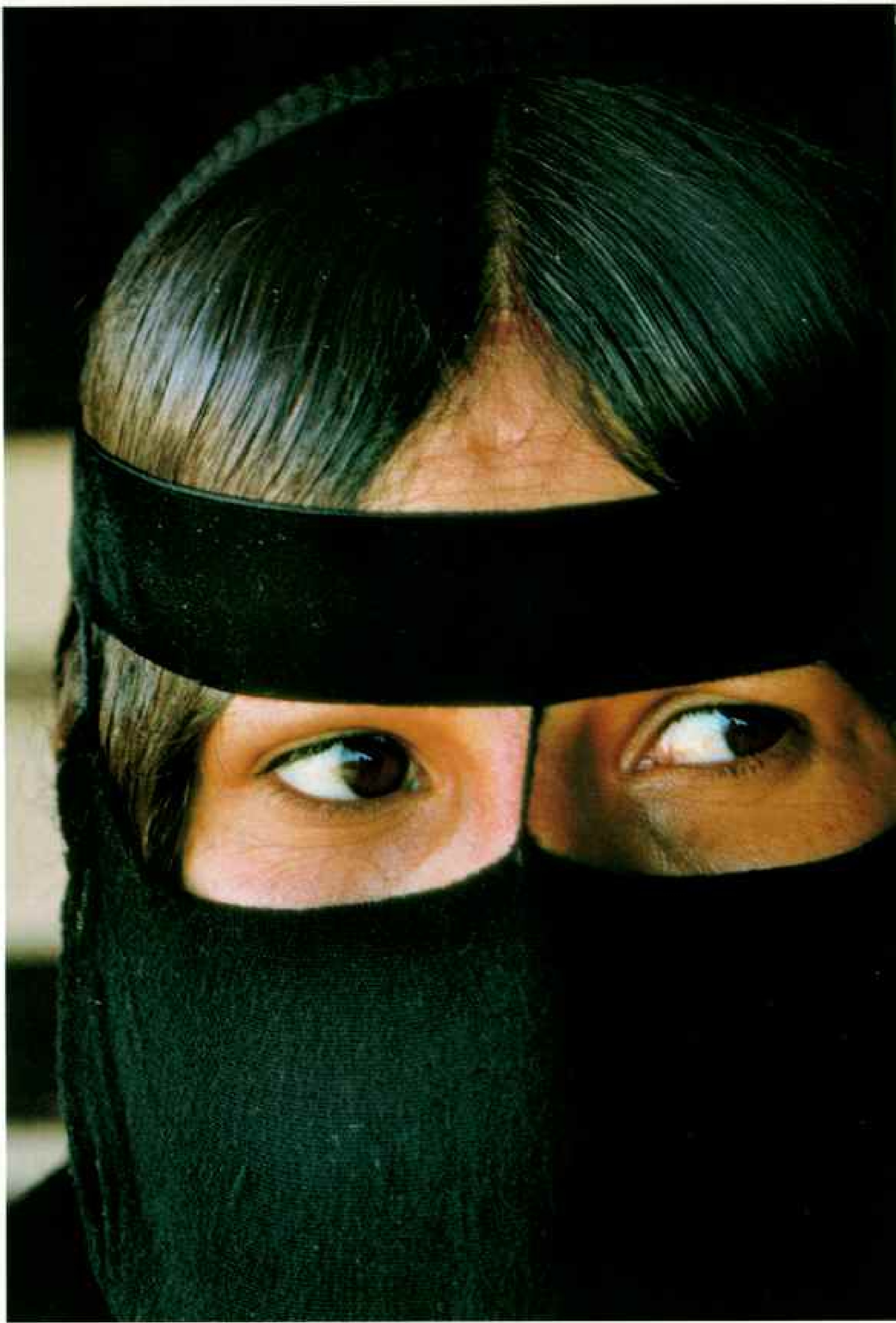
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**COVER:** *A colorfully clad Saudi youngster will don the traditional veil of her companion at puberty. Photograph by Jodi Cobb.*





By MARIANNE ALIREZA

Photographs by JODI COBB

NATIONAL GEOGRAPHIC PHOTOGRAPHER

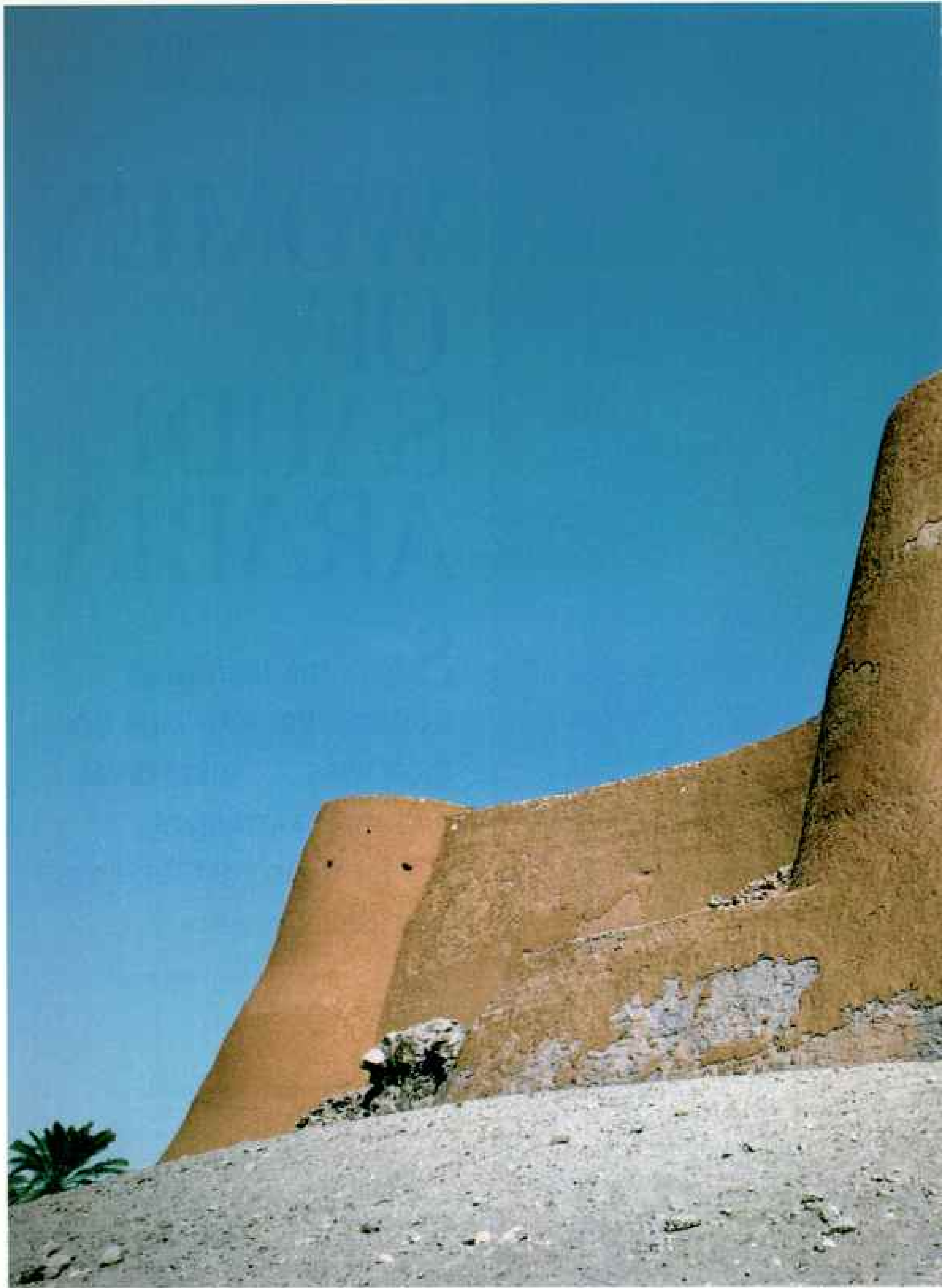
# WOMEN OF SAUDI ARABIA

Say to the believing women, that they cast down their eyes . . . and reveal not their adornment . . . and let them cast their veils over their bosoms. . . .

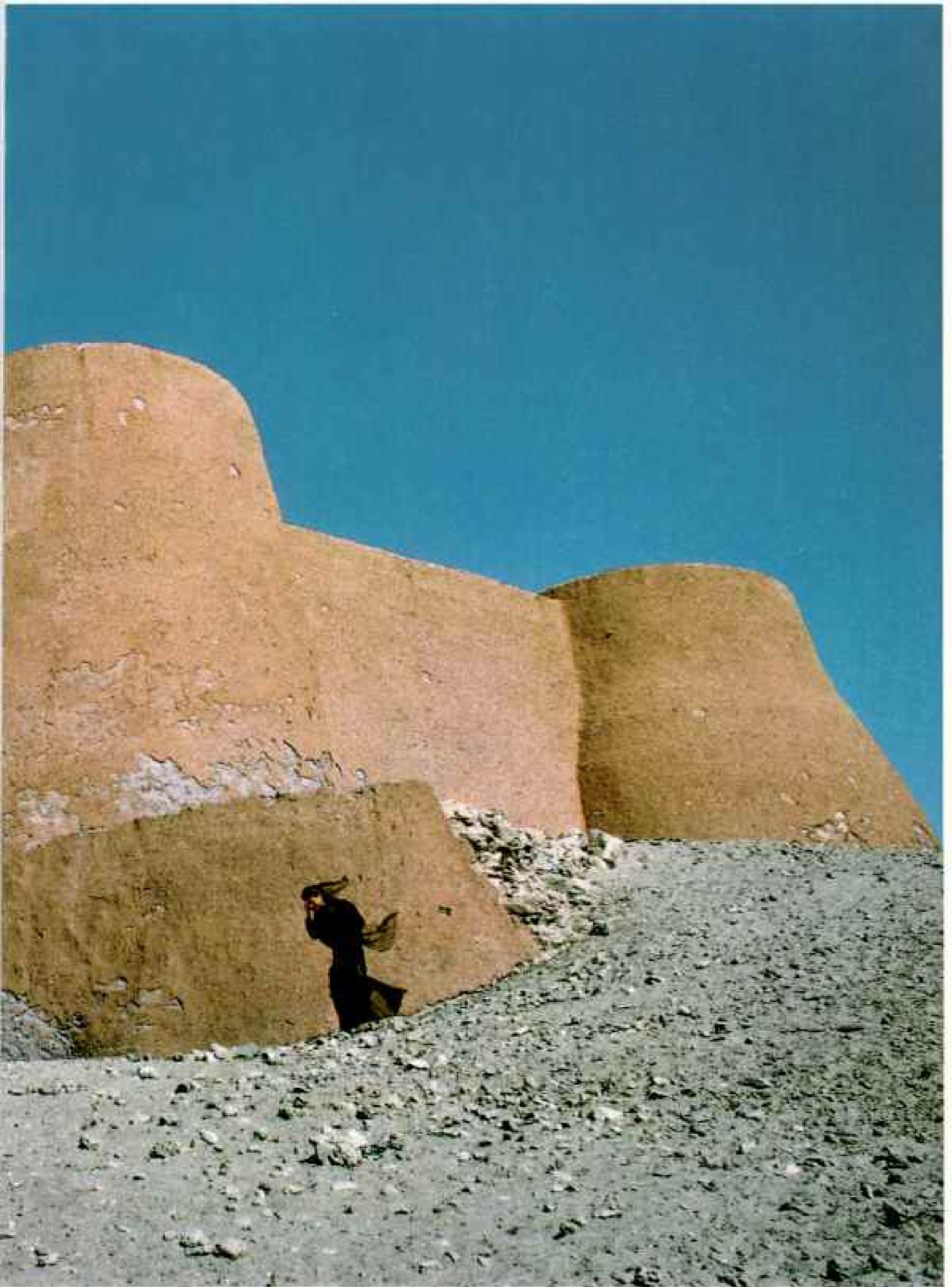
KORAN, SURA XXIV: 31

*VEILED TO ALL MEN* beyond her family, a young Bedouin woman wears the classic face covering of her people. Given only passing mention by the Koran, Islam's holy book, the veil is an ancient custom traced to India and Persia; it was adopted by Arabia's nomadic tribes, which enforced a strict code of female modesty. The tradition lives on in today's oil-rich Kingdom of Saudi Arabia—a male-dominated culture in which a man's personal and family honor depends on the conduct of females under his care.





*Only women may enter the ruins of a sunbaked citadel on Tarut Island, which encloses a spring used for bathing and laundry. Once home to an Arabian pearl merchant, the fortress repelled marauding tribes during the 19th century. Rooted*



*In nomadic warfare, the exalted position of males in Saudi Arabia was reinforced by the 18th-century advent of Wahhabism—a puritanical form of Islam demanding literal interpretation of the Koran on all subjects, including the conduct of women.*



*Happy with the arrangement, newlyweds Selma and Khaled Sadek celebrate their wedding in Jiddah. Despite a quiet trend toward love matches, most Saudi marriages are alliances between families. Many would consider this an ideal*



*union: The pair are cousins, so their contract enriches the extended family instead of weakening it. Islamic law gives a woman final approval over her family's choice, while a man is allowed as many as four wives—if he can treat them all equally.*





*Popularized by the elite of seventh-century Arabia, the facial veil and head covering worn by a woman on the beach at Jiddah contrast with youngsters' colorful dresses. Veiling became fashionable during the lifetime of the*



*Prophet Muhammad, perhaps in imitation of his many wives, who covered themselves in public at his request. Girls and boys are raised together until about age seven. Most girls start wearing the veil at puberty.*

“**S**HUF, SHUF,” sang Ibtissam Lutfy, giving me a start because the words mean “See, see,” and she is blind. We had been talking about Arabia in the 1940s, when I went to live there as the American wife of a young Saudi. That was a time when Arabian women, bound by tradition, veiled, cloaked, segregated, often illiterate, had little say in their lives.

“Yes, those were narrow days,” Ibtissam said. “But there are no more narrow days for me—and, besides, things have changed. We women have stretched our boundaries to the limit!” Now in her mid-30s, she overcame these same taboos to become a professional singer, something men didn’t do 20 years ago, let alone a young girl.

Impulsively, Ibtissam invited photographer Jodi Cobb and me to a wedding in her home city of Jiddah—but telephoned next day to cancel because her father would not permit more photographs of her.

Before we left Saudi Arabia, many other women from all strata of society would make similar apologies. In the sense that nearly three-quarters of a million girls go to school in the kingdom and thousands of women have earned university degrees and play a role in the progress of the nation, lives are indeed broader. But this is still a country where the man’s word is usually final, where even six-year-old girls cover their heads.

Jiddah means “grandmother” in Arabic, and—according to one legend—the city was so named because Eve, the grandmother of us all, was buried there. Her Arabic name is Ummuna Hawa, our Mother Eve. In 1945, when I first saw what is left of her tomb, it was one of the very few structures on the desert outside city walls. Today in the burgeoning modern city one has to search for it.

It was easy then, however, to imagine

Eve in that place. The land still had the look of Old Testament times and was still observing many Old Testament customs: the covenant of bread and salt, sheep slain to seal vows or thank God for blessings, and images of God’s creatures forbidden.

This was Arabia before the Kingdom of Saudi Arabia was carved from the peninsula to become a political entity in 1932—and for a long time afterward. In the great reaches of deserts, plateaus, mountains, and valleys it was a struggle to survive, and the generally



*No men are allowed when guests at the Jiddah mansion of Princess Jawharah, a wife of the late King Faisal, remove the veil for their frequent get-togethers behind closed doors. Believing it improper to have her picture taken, even by a woman, Princess Jawharah left the room as Jodi Cobb photographed her banquet, spread in the traditional manner.*



stark barren desolate whole of the interior remained closed to outside influences.

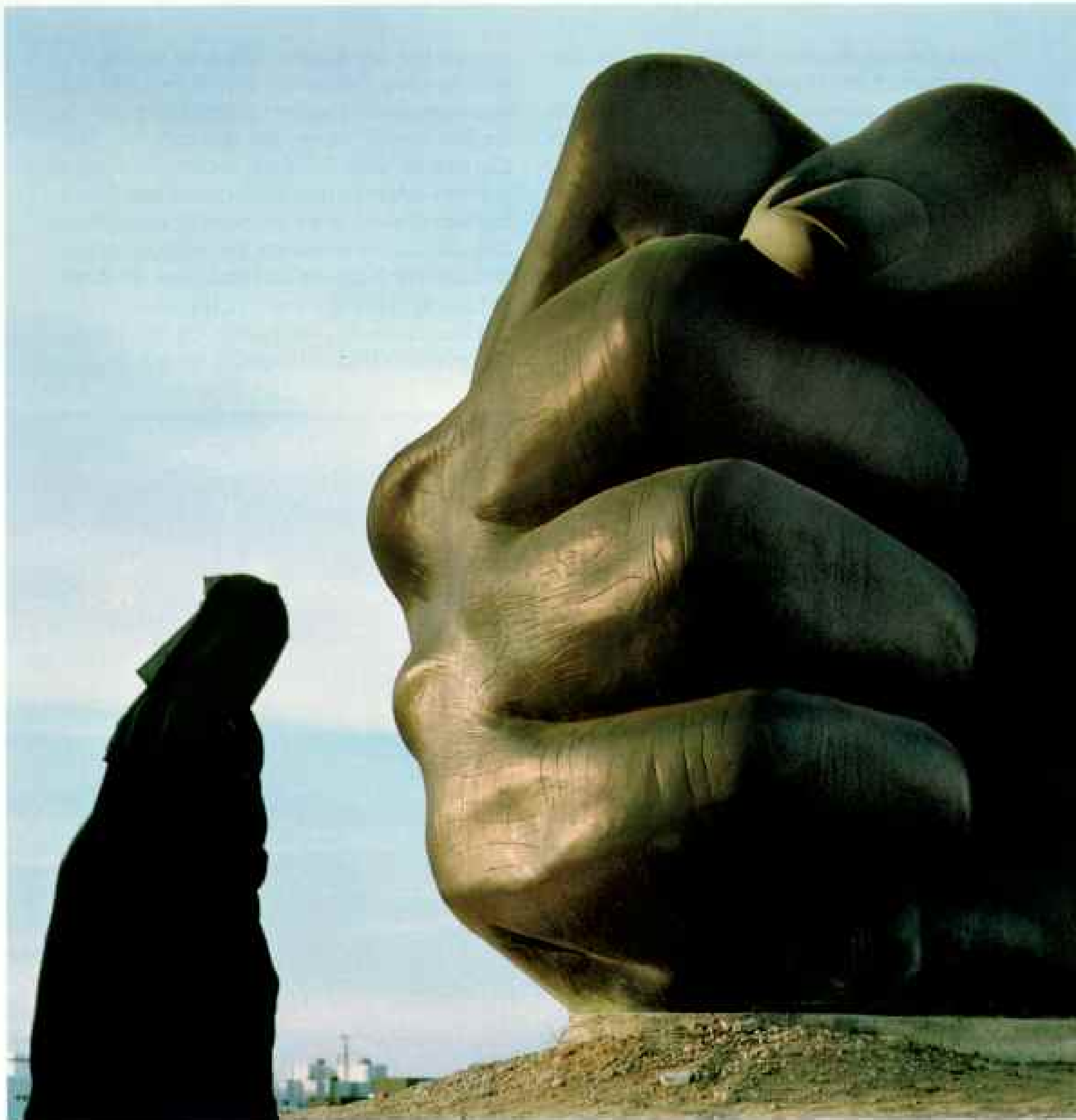
For city women like us, just about the only activity (besides living communally within the extended family) consisted of leaving our harem quarters to visit other women in theirs. Family men or male servants did the shopping. Older women ran the household, with younger women having few such duties. Yet despite this hierarchy of age, everyone belonged—even I, even before I learned to share and care as a small

part of the big whole. "We love you as we love our son," were the first words I heard from my mother-in-law, Asma, and my extended family sailed me through my first Christmas with a roast turkey and gifts placed under the tree. Mother had had flown in from Cairo. With wonderful sensitivity they helped me celebrate my religious feast. Outside the walls we had little, but what we did inside the walls was live together.

Then came oil—or rather, by the 1950s, the revenues from oil found in the late 1930s.







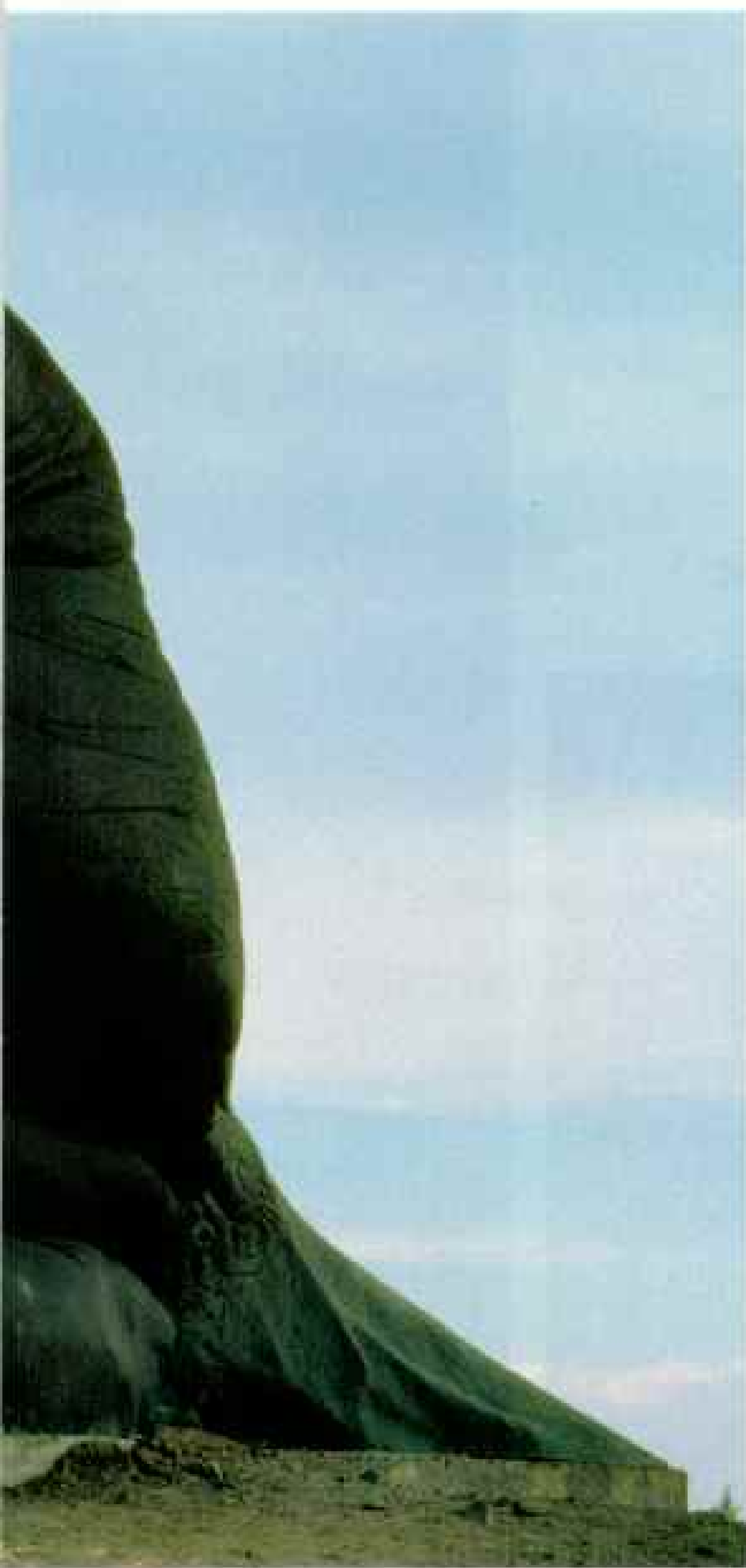
Paid \$250,000 in gold for the concession to look for black gold, King Abd al-Aziz ibn Abd al-Rahman Al Faisal Al Saud hoped in his heart for water, it is said. But oil it was, popping the first cracks in old Arabia and opening the way to the new.

**T**ODAY, AS IF OVERNIGHT on history's clock, Saudi Arabia has a new face from development, modernization, industrialization; its people adapt to change while simultaneously being educated; and there's a new reality whose meaning and direction can still not be fully assessed,

particularly as concerns women, as concerns Islam.

Islam is the one thing not changed. It is the state, the moral and civil code; it is all matters big and small, ever imbued with an awareness of God's will and word. Now, though, the big and small changes unloosed over the Saudis have created a need to rethink how God's will and word apply in their world of today and to invent ingenious ways to make it all fit together.

Sunni Islam as it is practiced in Saudi Arabia has no hierarchy of priesthood, not even a formal clergy, but there is no shortage of



*An iron fist dominates a passerby in Jiddah, where it decorates a traffic circle. Even here, in the most worldly of Saudi Arabian cities, a woman cannot board an airplane or stay in a hotel without written permission from a male relative. And her modesty is zealously guarded by the muttawwiun—morals police armed with camel prods, who publicly shame anyone offending their sense of propriety.*

times, that women are properly covered and observe the off-limits signs on, say, popular disco-music cassette shops, where mingling might provide a breeding ground for assignations.

The General Presidency for Girls' Education takes its top orders from men of God, keeping the threads of religion tight and binding—modernity may pad the fabric of society but not tear it.

Men, of course, go right on doing what they do, so the import for them is nowhere near what it is for women, who certainly seek no diminution of their role as Islamic women but may nonetheless perceive that role differently—especially as they learn to read and understand for themselves the legitimate rights given to them by Islam in the seventh century A.D.

In Islam the woman has a fully independent legal personality. She can inherit and own property, can divorce in certain situations, and has the same religious duties as a man: "O mankind, We have created you male and female, and appointed you races and tribes, that you may know one another. Surely the noblest among you in the sight of God is the most godfearing of you" (Koran, Sura XLIX:13).

Man-created traditions and practices often denied women the rights due them, and years ago, while living the restrictive life, I often blurted to my mother-in-law, "But how can you accept this, why do you allow it to be?" She answered always, "It is our way." Well, the way has changed. And yet. . . .

Izzat Mufti of the Saudi Ministry of Information clearly stated that (excepting

definitive religious directives for the faithful. These emanate from a powerful body of Islamic scholars called the *ulama*, who cling tenaciously to strict puritanical tenets and moral codes and whose minds are set in archaic and traditional beliefs, particularly regarding the decency and morality of women. Public-morality committees, the regional Societies for the Preservation of Virtue and the Prevention of Vice, ensure strict compliance with religious requirements and what passes for religious requirements. Salaried morals police patrol the public domain making sure that businesses close at prayer

---

Marianne Alireza, author and lecturer, has written about her own life in Saudi Arabia in her book, *At the Drop of a Veil*.

*Pioneers in any profession, relatively few Saudi women have entered the work force—despite a boom in education created by the kingdom's oil wealth—and usually in fields where they won't come into contact with men. Baby boys are another matter: Dr. Hanan Ali al-Subeai (right) examines a newborn at Airbase Military Hospital in Dhahran. Her ghata, or head covering, is considered a veil.*

*Encouraged by her family, Huda Awad (below) opened a contracting business in Jiddah—and now has 40 men working for her. "This to me is the world," she says. "I'd never give it up."*



military installations) taking pictures was not forbidden, so Jodi and I hid ourselves to Jiddah's old gold market as a test. Espying an interesting overhang of an old house on a shadowed passageway, Jodi angled her camera to catch it when, quick as her eye, an armed policeman approached with a warning and a shake of his head.

"But it's just an old house," I protested, and although my Arabic seemed to surprise him, the answer was still no. We complied more passively than we wanted, ambling around the old bazaar. He watched our every movement and *Zut!* came toward us again. Drawing close, he hissed, "Go ahead

with your shots, just be quick about it!"

I must say this was nice, but not exactly a harbinger of like privileges to come. Photographing in Saudi Arabia is perhaps even more difficult now than before. King Abd al-Aziz in his time successfully convinced the ulama that photographs were only combinations of light and shadow, posing no threat to God's creations. But nowadays many shy from any photography, though others object only to public picture taking.

Yet there are changes. For local color, Fridays on Jiddah's corniche along the Red Sea is hard to beat. Miles of sun-protected picnic areas and playgrounds line the shore



where hundreds of Jiddawis *en famille* gather in their own private public spot—men, women, and children together—a notable difference from the days of men with men in public and women with women in homes.

**B**UT IT IS UNDERSTOOD that being in public does not mean going public. Women's head coverings (not always over faces) stay on, and cloaks, though billowed by sea breezes, are kept firmly in place with ease and grace while ladies serve food, play with children, swing on the swings, or make the rounds on a Ferris wheel. But never mind, it's the

outing that counts, so credit the government for planning and providing, and credit the change in mentality it represents.

Rural and nomadic women have always enjoyed more freedom than their city counterparts. *Badawiyat*—Bedouin women—are still the only Saudi women driving, far from the crowds and the morals police, with pickup trucks and water rigs replacing the camel and treks to the wells on foot.

We saw many Bedouin at a camel market one day, men with their great beasts and women sitting on the sand selling handmade goods, twirling wool into yarn on hand spindles with big skeins of the coarse stuff by



*Motorized nomads, the Bedouin bands near Riyadh may swap their camels for pickup trucks and battery-powered TVs but prefer desert life to a house in town. Dwindling in numbers today, the hospitable, hardy nomads historically set the tone for much of Arabian life.*

*Bedouin women veil their faces more strictly than city dwellers but enjoy greater freedom of dress and movement. Besides managing the family tent, some have even taken to driving the tribe's water truck (facing page). Driving is a privilege denied women in the city.*





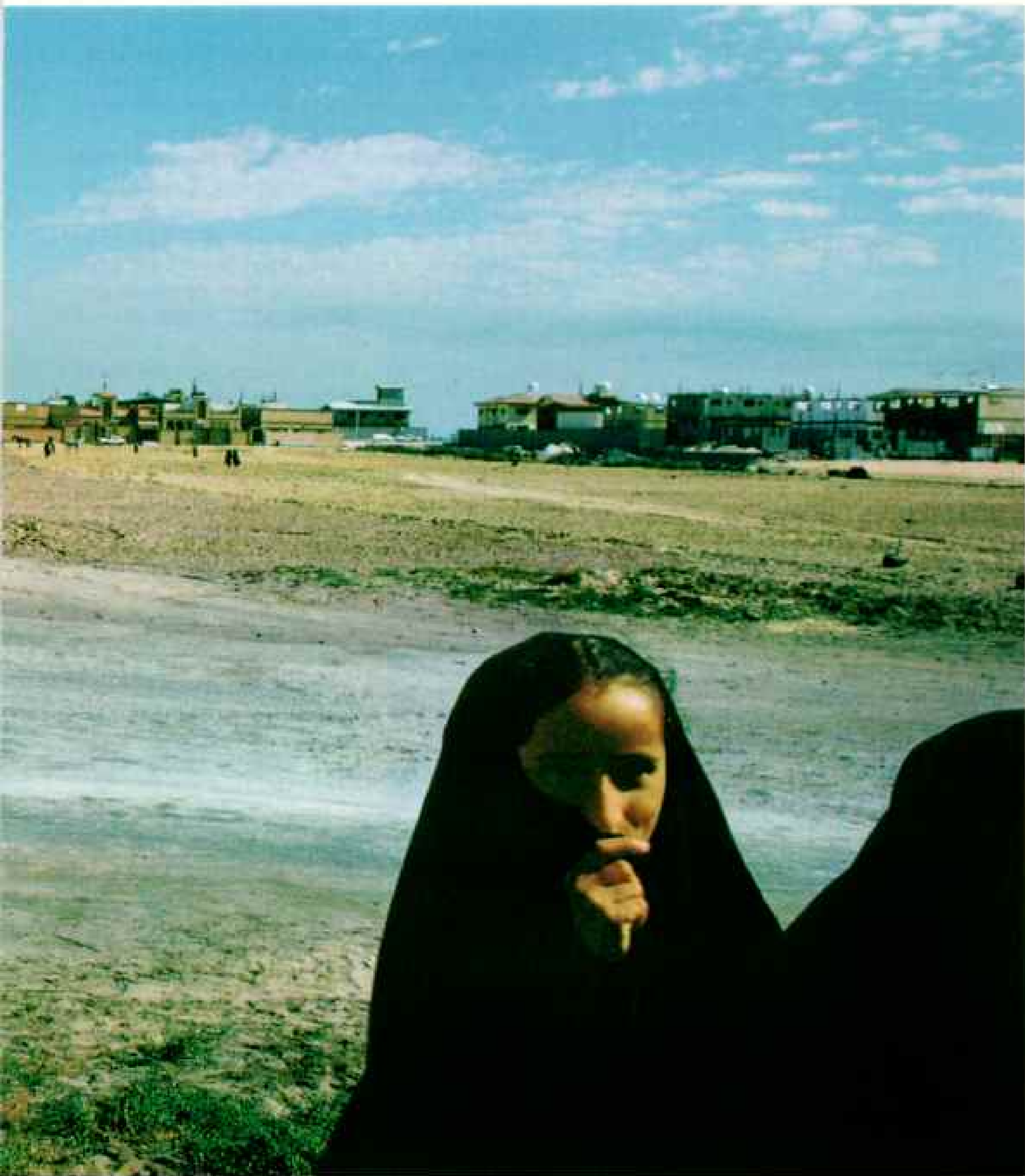


*"I was shocked to see girls this young wearing the cloak," says the author, who encountered this group of schoolgirls near Qatif oasis in the Eastern Province. Veiling customs vary, and this region, home to the country's Shiite minority, is one of those known for its conservatism. Not available officially until 1960, public education is free to any Saudi girl whose family permits it.*

their sides. Without question they accepted the sight of two lone foreign women wandering among them. My speaking Arabic didn't surprise them. (Doesn't everybody?) We were there so we were there, and only one question was important: "Are you Muslim?"

"No," said I, "but God is One, you know," and heads nodded, smiles appeared, and all was right with the world.

Their hottest sale items were hand-knit



camel-udder snoods that prevent baby camels from nursing at will. I surely would have bought one of their beautiful tents had they not been so bulky and heavy, but I settled for tasseled, colorful lead ropes and halters for my stateside Arabian mare.

Welcomed into part of a rude complex of pens and lean-tos near Taif one day by three outgoing, pretty daughters of a goatherd, Jodi and I drank the proffered tea while they

proceeded to learn as much about us as we did about them. They kept goats while their brothers went to school, and they didn't know how old they were, but they loved the Polaroid snapshots we took of them and carefully hid each one away. I wondered what ten more years would bring for them.

Ibrahim Ahmad al-Sayed, a member of the Asir governor's staff and the director of the provincial tourism department, came



Better than a bank account, jewelry has traditionally been a prudent investment for women in a land where a man can divorce his wife by saying "I divorce you" three times. For Bedouin silver, there's the women's suq in Riyadh, where a fully veiled shopkeeper models her wares.

Riyadh-born Mona Khashoggi (below), now living in London, shops for jewelry in Chelsea.



with his driver to take Jodi and me around the countryside near Abha one morning. Stopping at a two-in-one village—old ruins next to a living settlement—I called to an elderly village woman, "Peace be upon you!"

"And upon you be peace!"

"May we visit you?"

"Welcome, welcome," she said.

In layered village garb, some of it embroidered, some printed, some black, and no veil but a black head wrap that she tried to angle slightly over her blind eye, she led us to the second-floor sitting room of her tower-like home. Leaving our shoes at the threshold, we sat on low mats along walls featuring a painted running design and swooping electric wiring and were barely settled when to my utter surprise Ibrahim joined us and, wonder of wonders, even the driver. That would never have happened in Jiddah—certainly not in Riyadh—men strangers visiting the lady of the house.

This widowed matriarch of the al-Asiri family, with three sons in the army, kept the

home, the goats, and the adjacent farm, with her daughters-in-law (who—aha!—did not appear) and seven grandchildren, four in school, three still too young.

We talked and talked, strangers in that hospitable place. Coffee was declared not enough, we must stay for a meal, but we begged off, saying *Inshallah*—God willing—we would one day return. Two days later we were back in that living room, joined after word spread of our return by a young male villager and the local religious sheikh. The tall, well-groomed, handsome younger man greeted our hostess with the deference due her as an elder and then shook our hands, as did the sheikh, a short man of perhaps 50 with an open manner and a friendly gaze. He so rushed his speech in a desire to know about us that I had to ask him to repeat, but we covered introductions and backgrounds, and I discovered that he knew of my family.

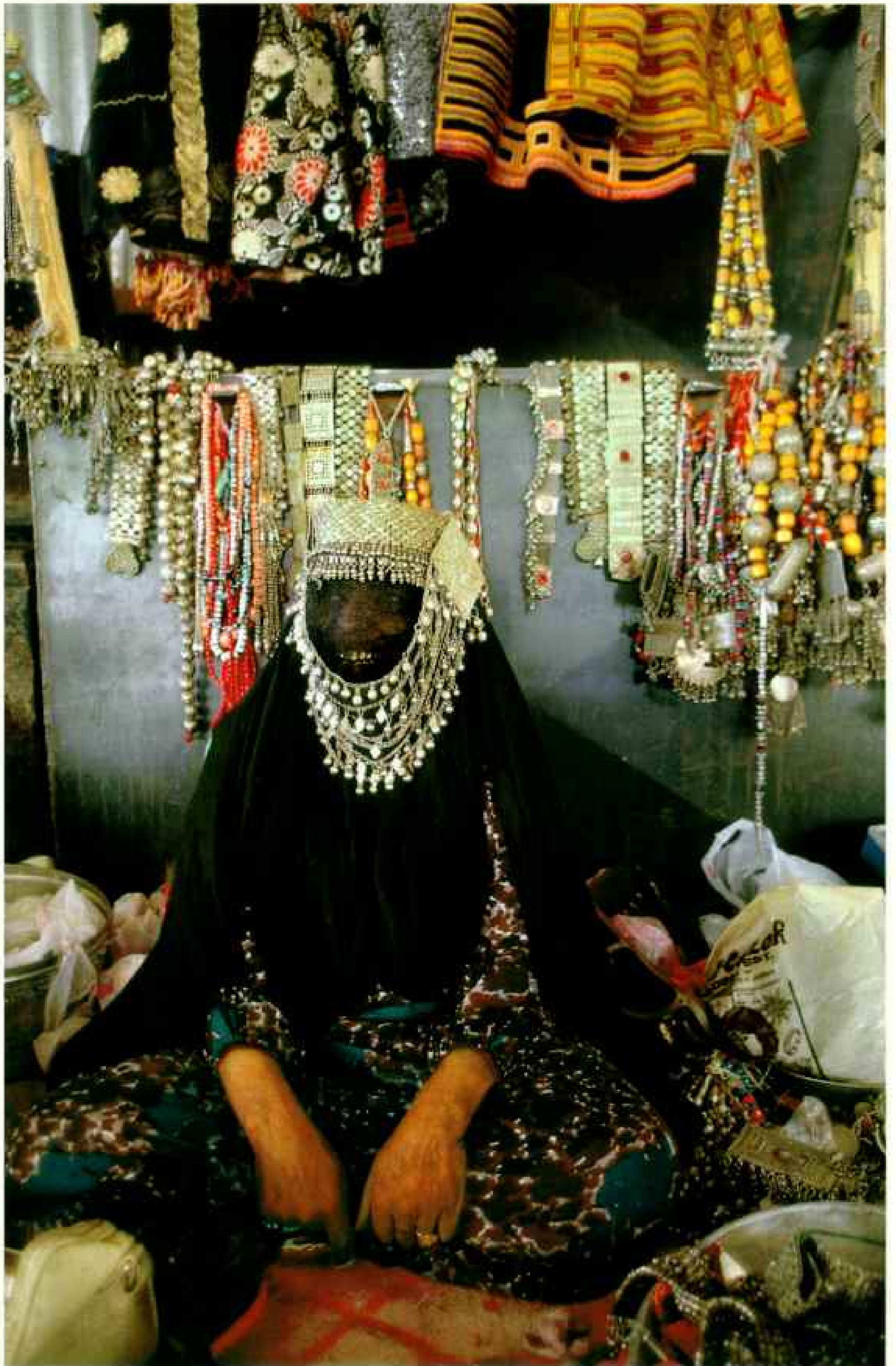
"Why did you not convert to Islam?" he queried.

"Because I believe in the same One God you do, and the stories I know from the Bible are part of your history too."

"True," he said, "but Islam is better; our prophet is the last after Noah, Abraham, Moses, Jesus." And we left it at that.

**I**N RIYADH we met a citified Badawiyah, Umm (mother of) Abdallah, who lives in an apartment and has a hospital technician daughter and a pharmacist son, but keeps her makeshift stall in the Bedouin market selling everything from gold, turquoise, and silver to ragtag notions and remnants of old Bedouin clothes.

We sat there on the ground with her and friends, partaking of dates and Arabic coffee served from a coffeepot that was identical in shape to the traditional brass one, but it was a thermos made of plastic. Other signs of the times are traditional *madass* (men's sandals) available now in the fine leathers of Italian shoemakers and the ultimate in veils and



cloaks bearing logos and labels of famed Paris couturiers.

Umm Abdallah loved adorning herself for photographs with every possible piece of silver, but her fun and ours stopped when a male passerby shouted a protest and announced he was going for the police.

"May you be blinded and boiled in oil," Umm Abdallah shouted after him, but she scurried to hide all camera gear in Bedouin baskets, under old clothes, in an old trunk. That time the police did not come.

Women such as Umm Abdallah are only partly out of the old time. The real changes lie in the generation or so after them. Today's educated women might still wear the veil, might still be the wives and mothers they have always been, but they have become other things too.

In their ranks are teachers, computer technicians, social workers, laboratory technicians, physical-fitness instructors, physicists, engineers, bankers, filmmakers. All these when the first public schools for girls weren't approved by the government until 1960!

"Thank God things have changed for us!" This not from the younger nurses at a hospital dispensary but from a widowed mother of seven (the oldest a boy of 15) just now learning to read and write in the government program for adult illiterates, having to juggle time seeing to her children, working required hours, attending class.

She has a serious need to work, but the young girls were there because they wanted to be, succeeding over protests of family men who look on nursing as a demeaning occupation for young women. They give modern treatments, instruction, and care in the dispensary and in patients' homes, a great change from the folk medicine, cupping, and *kawi* (applying red-hot irons to the body) so prevalent before.

At King Abd al-Aziz University Hospital in Jiddah I asked Sabah Abu Znadah, coordinator of training and development, how she had gotten into nursing.

"Do you want a flowery answer or do you want the truth?" she fired back with a smile. In truth she wanted to be a physician, but she missed the college's deadline for applications. Nursing was next best. "So I went for it," she said, "and now I'll fight for it."

Most Saudi professionals we interviewed "went for it" in one way or another. Some came from traditional families whose men objected to their working—"not," said Sabah, "because they were not open-minded men or too strict, but out of fear that society would look down on them."

Many had uneducated mothers pushing daughters to achieve what they never had; others had family support all the way. "My father always told us to get an education first, because the more like us, the more others will follow," said Fatmah Yamani, chief of personnel at the university hospital. One of her colleagues said that her father is now proud of her in her profession, but initially objected so strongly that he sent her to Jordan, where she found the "too free life" uncomfortable, so she returned to sit idly at home until her father gave up and gave in.

**H**OWEVER they made it, women who have achieved avoid doing anything that could stem the tide of advancement. They proceed quietly on their merits, wanting no backlash spoiling things for them and for the women who will come after them.

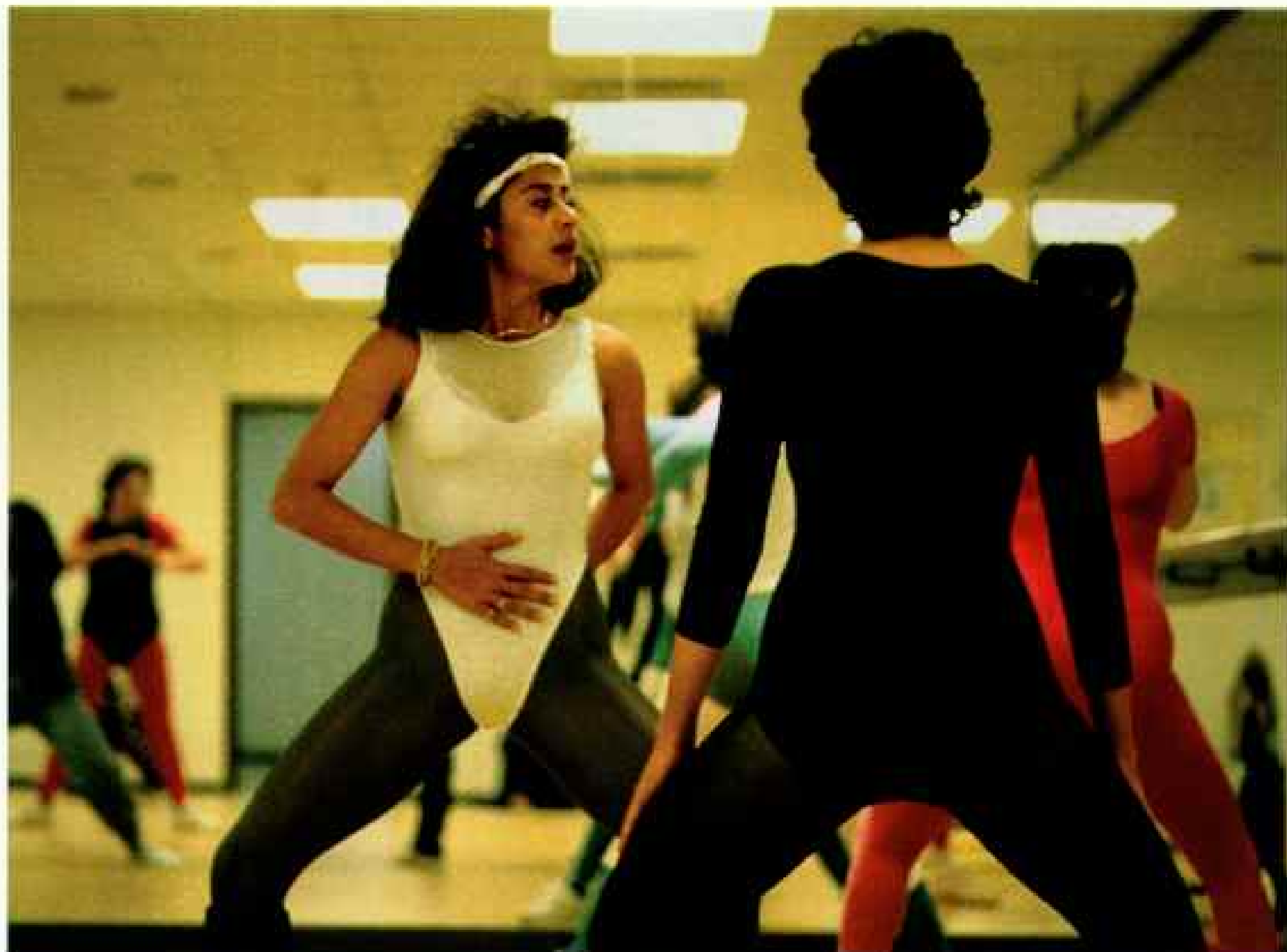
Although most work in all-female facilities, some doctors, nurses, administrators, radio announcers, journalists do work with men. Long skirts, long sleeves, head scarves are customary for women on the job. "There is no problem," said one hospital worker. "We are well accepted, get the same pay, and men here want more women in jobs, appreciating our efforts and respecting the levels of education that put us here."

"There *are* objections around the country though," said another. "Someone wrote the newspapers asking how their girls could work next to men. Then everyone waited to see what would happen and *nothing* happened. Someone must make the first step."

"Your steps seem big to me," I told the women at the hospital. "I've heard that girls consistently outdo boys in scholastic testing, and that in one graduating class girls were outnumbered thirty to one but took the top five places. How do you account for that?"

This got a laugh and then a bigger one with the reply: "That's because boys have cars, and we must stay home and study." Judging from the letters-to-the-editor





*Dancing to a new tune, Maha Bukhari was all Saudi until she attended college in the United States. Now returned to Jiddah, she teaches aerobics at al-Faisaliyah, a women's welfare center. In 1980, concerned that students were being "subjected to unfavorable influences of the Western societies," the kingdom barred women from study abroad unless accompanied by a male family member.*

columns in local newspapers, a lot of women would like to drive too, and by such means they keep asking the king for permission.

Another slant on this subject came during a later interview with a Ph.D. requesting anonymity. "As for women driving," she said, "some people talk about it, but most feel that driving here is very dangerous and initially for women would be as disastrous as when men started. Accident factor aside, it would be worse because men unaccustomed to seeing women drive would follow and bother. It would be great sport!"

Seeing young ladies running computers was enough to make one realize what inroads education has made to future directions. Thirty years ago there were only a few high schools for boys, and in 1957 the first university class consisted of only 50 young men. The class of '73 was the first to graduate women, their number no greater than

the total of hospital personnel we interviewed in one day in Jiddah—a dozen!

Same spark too. When those graduates didn't find their names on the commencement program, they set up such a hue and cry that a special ceremony was arranged. Two thousand women arrived to celebrate with them, giving the affair the joyous atmosphere of a wedding when they shook the rafters with a piercing sustained ululation.

At the King Saud University College for Women in Riyadh, students wearing black cloaks are let off by car and driver at the guarded gate. Once inside they fan out in waves of brighter colors, as veils and cloaks get folded away and the black sameness becomes laughing young women in pretty frocks hurrying to classes.

Unveiled women may not be seen by their male professors, so courses are conducted via closed-circuit television, each student





HC45



*At home in two worlds, Mai Yamani, daughter of former Saudi oil minister Ahmad Zaki Yamani, divides her time between Oxford University (top), where she works on her doctorate in anthropology, and her homeland, where she both studies and practices traditional Arab customs such as decorating her hands with henna. Given a choice, she would rather stroll with her daughter through old Jiddah (left), where windows are latticed to shield the women inside from view, than through the streets of London. "I'm a Saudi woman," she says. "I like my veil."*



having her own desk set. If, as the professor speaks, the student has a question, she has only to pick up her own telephone by the TV and have direct-line access to the lecturer.

Before their own universities, women studied by correspondence, and Faiza Abdallah al-Khayyal is one who worked as liaison between professors and female students as long ago as 1969, after she received her B.A. in sociology from Vassar.

"You met with the professors?" I asked. "No," she laughed, "I'd telephone them."

Even participation in modern sports—limited in public to men and boys—met

initial objection from religious leaders who took exception to shorts and bare legs and claimed that televised games encouraged Saudi youth to neglect studies. The national soccer team scored well though. It won the Asia Cup in 1984.

**I**N A TWO-HOUR LUNCHEON with professional women, we heard of government policies for women backsliding from enlightened to more restricted; of efforts to deflate curricula to bare-bones studies geared to making better wives and mothers; of formerly productive training



Screened from contact with his female students, Samir Badawi teaches by closed-circuit television at King Saud University College for Women in Riyadh. Students (who cleared the room when photographer Jodi Cobb brought out her camera) ask questions by telephone. This system was devised by the ulama—a powerful group of religious leaders who advise the royal family on every aspect of life in the kingdom. "If a man and a woman are alone in one place," goes a



proverb, "the third person present is Satan." Saudi Arabia permits no coeducation beyond kindergarten.

Official censors keep forbidden sights from reaching Saudi eyes through foreign periodicals (above). They also blot out references to pork and alcohol.

and study facilities shut or limited; of access to the workplace narrowing so that highly qualified women are stymied in their careers. Asking for a summing-up statement of their feelings on this, we got this cannonball response: "HELP!"

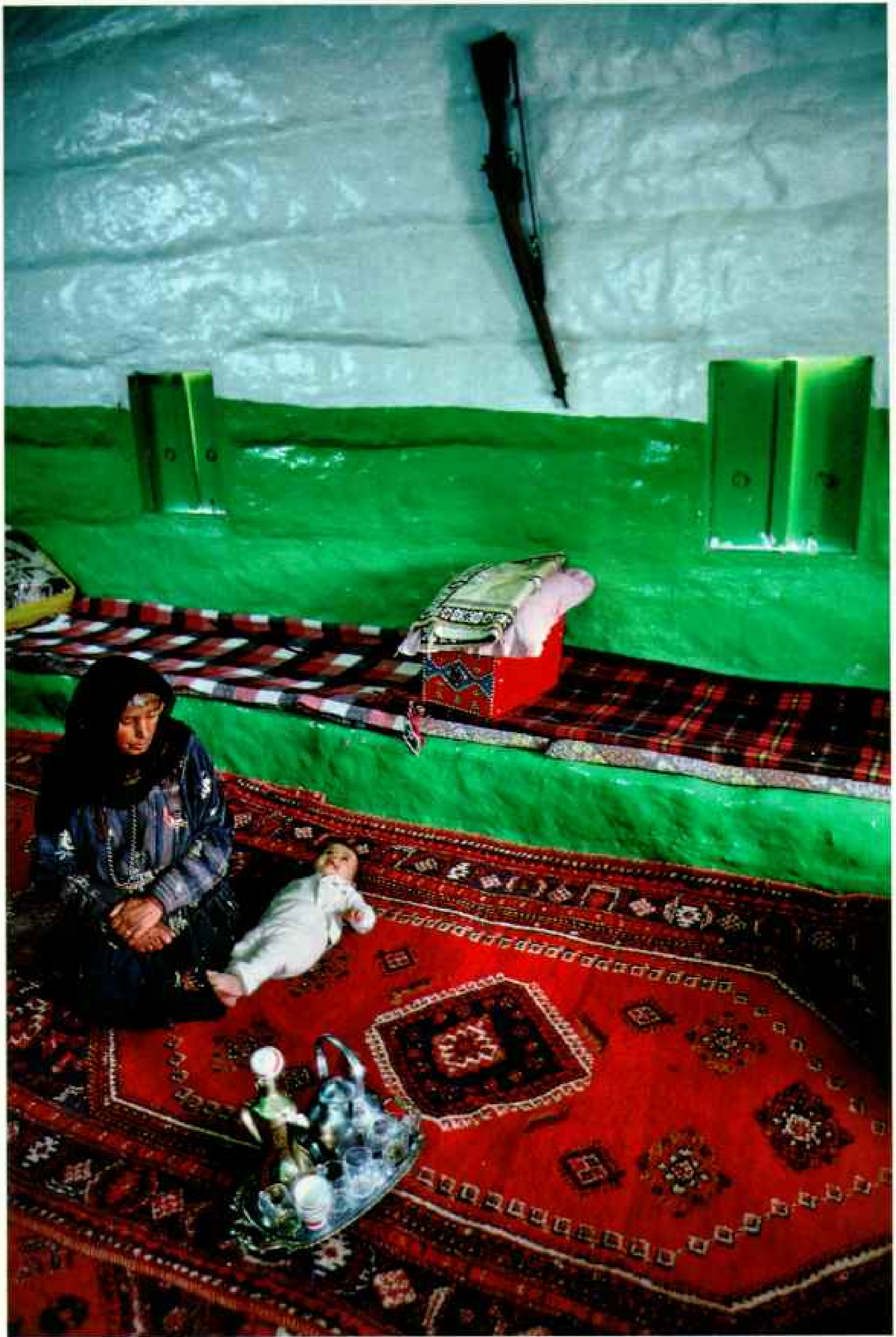
Women, their faces exposed but their heads covered, appear occasionally on television as newscasters and special program presenters. Samar Fatany used to be one of them. She is now on radio shedding light on Saudi laws and culture for English-speaking listeners.

Educated abroad, Samar wants to prove

to foreigners that Saudis are not any different. She sees some of the same adverse effects of change in her own society as are seen elsewhere—the misuse of money, time, and leisure. She is so concerned that in off-hours she runs, from her home, a club for children and homemaking classes for young wives and mothers.

Ghada Alireza Zahid, wife, mother, and expert in glass and porcelain painting, receives at home each Saturday and Sunday from nine to one o'clock about a dozen young women who arrive on time, toss off wraps, retrieve unfinished work from the previous





week, find a work spot and have at it. Ghada supervises, and the modest display of finished articles proves the seriousness of the women's efforts. "I don't know if I have any talent," said one, "but now that I am doing it, I am really interested."

Tucked in corners of the rambling old buildings that house welfare societies are genteel, quiet-mannered older ladies who know not the least thing about newer trends, arts, crafts, and fashions, but know a great deal about traditional embroideries, the cut and drape of cloaks and capes, fine tatting and drawn-thread work, and how to turn minuscule hems on fine silk veils, and they are ready on a regular basis to pass on their skills to anyone wanting to learn.

Almost too late are the beginnings of concern for preserving the knowledge of yesteryear, but artist Sofia Bin Zagr feels an urgency to do so through her canvases. Seven or eight years into a project on costumes, she seeks authenticity. "But it is difficult to find two people with the same description of an old-time dress," she says. "The young don't wear them, older folk put them in chests and forgot them, and the very old can't even imagine why I'm asking."

Today's apparel could be anything imaginable because everything imaginable is available, but veil and cloak lend anonymity and appearances are deceiving. Underneath might be a high-society lady in haute couture, a high schooler togged in blue jeans and a T-shirt, a villager in colorful cotton, or an old-time lady in her old-time dress. Anything goes, but the outer layer—with slight variations, perhaps—remains the same.

It is a shock to see sedate cloaked figures peeling to leotards in a fitness center to do routines popular the world over. Some to whom the concept is new have tried to remain modest and decorous in their wraps while pedaling bikes or walking treadmills, until the machinery demonstrates its nasty tendency to gobble loose flaps of material and long veils attached to quite long hair.

*A world of color and hospitality is the realm of women in remote, mountainous Asir, part of the region that the Romans dubbed "happy Arabia" for its plentiful rainfall and less severe life-style. Veiling is not as strict, and male visitors are permitted—even when the menfolk are away—in homes like that of the al-Asiri family (facing page) in al-Fayyah, a village where many a home has its own TV.*



**N**ATION AND NATIONALITY are the objects of growing interest. Thousands of women visited the "Riyadh: Yesterday and Today" exhibit in that city in April 1986, and Saudi women were the focus and the honorees at Saudi Day, an event sponsored by the Jiddah International Women's Group.

Gala by any definition was Ladies' Night at the King Faisal Foundation's opening, where Queen Iffat, King Faisal's widow, and Their Royal Highnesses Princesses Sara, Latifa, and Lulu received hundreds invited to enjoy the multimedia exhibits depicting the kingdom's history and King Faisal's part in it, the sumptuous buffet on the outdoor terrace, and a spectacular advanced state-of-the-art laser show. Some of the older ladies wept before exhibits of times past, and the young perhaps had trouble identifying with them, but their hostess Queen Iffat is most certainly a link to both.

The first model school for boys in the forties was her doing, as was in the fifties the



*Divided by sex and custom, a Saudi family spends Thursday evening relaxing by the Red Sea.*

orphanage called House of Affection, forerunner of official government education for girls. Its first high schoolers graduated in 1965. Today there are 8,000 educational institutions with nearly two million students, 700,000 of them female.

Remembering the strict segregation of the past, I am still amazed at mixed society in public. Married couples can be seen shopping together, dining tête-à-tête in public in a hotel or restaurant, but still cherished and jealously guarded is their personal privacy. Increased one-on-one sharing as husband and wife, as parents, may be due to a certain

fragmentation of the extended family, with the added factor that some wives are now as educated as their spouses.

Private groups mix too. Couples join good friends in each other's homes with astonishing frequency—three or four times a week—making a shared enjoyable little world within the bigger confining one around them. They enjoy weekends together, travel together, share joys and problems in support of each other, and their young folk associate freely—all forming a circle of friends that becomes a new extended family.

Children and teenagers in these situations





*Men often observe Friday, the Muslim holy day, at the mosque, while women pray at home.*

obviously enjoy freedom and activities unknown where the conservatism of the people keeps life within traditional traces, where even very small girls wear the black cloak and head covering, and the scene of a hundred or so of them frolicking on paths home from school is startling.

**M**ARRIAGE IS SOMETHING for which many now wait longer than before, wanting an education first. This is not to say that pressures to marry are not still there. "Our Girls and the Right Path" was the subject of a

seminar in Jiddah in 1986 where Saudi scholar and Professor of Islamic Culture Ahmad Jamal indicated that marriage is a woman's primary obligation and takes precedence over the pursuit of learning. Unless, that is, a husband agrees informally or by legal prenuptial writ to her continuing studies after marriage.

Just getting married poses problems for some because of prohibitively high dowries and excessive outlays for celebrations. One sheikh representing ten tribes attempted to set dowry limits in his region when they reached 160,000 Saudi riyals (\$42,000). He





*A designer veil sports the logo of Yves St. Laurent, reflecting a new worldliness among Saudi women, whose lives have been opened by education and fresh opportunities. Most accept the veil for privacy and protection from male harassment, not as a symbol of oppression, and cling to a tradition that defies Western understanding.*

proposed maximums of 10,000 riyals plus some jewelry and a gold watch for a virgin, and 5,000 for a divorcée or a widow. One news report in 1986 listed the nationwide average as 100,000 riyals.

A Muslim can have four wives legally at a time if—a big if—he can give each wife equal material goods and equal time. So monogamy is by far the norm, although divorce rates are on the rise. With a man allowed to divorce his wife without stating reasons, there can be instances where the divorcée faces dire problems. Women can divorce too, given certain reasons outlined in the Koran, but instituting such action in a male-dominated society can be as difficult as trying to counteract any unfair conditions unilaterally imposed on a woman and children by an uncooperative or vengeful husband.

**L**EARNING TO READ may lessen the incidence of such situations, as women come to know what Islam truly wants of them and for them. Along with those individual rights to inherit, own property, and divorce, Islam also has provisions for prenuptial contracts and deferred dowries (contingency amounts set aside for the ifs and whens), and no infringement is brooked of what is lawfully theirs. Women have always owned property and handled their moneys, even before education and from behind the veil, and as the country grew and developed, so did women's investments and holdings, and this gave rise to the proliferation of women's banks.

With all that women *can* do, there are things even today that they cannot do, such as board airline flights without written permission from a male family member or check into any of the kingdom's hotels without a letter in hand from a male relative or official sponsor permitting them to do so, and this also applies to foreign women.

Jodi and I were forced to bluff our way onto a domestic plane (breathless success enhanced by the beautiful koranic prayer for all travelers always intoned over the

intercom before takeoff), and at our destination we had to seek hotel permissions from a local police captain. I wanted no questions on how I had come to know Arabic, so when the station guard stopped us, I launched into a comic English routine that went like this: "Me no husband, *she* no husband, *hotel!*" Whereupon the dear grinning fellow took us to his leader, who was sound asleep on the floor of an upstairs room. We got our letters, but so much for the man/woman thing.

One distinguished gentleman friend regards the travel restriction as a source of shame and embarrassment when he or one of his five brothers must sign for their beloved mother when she leaves on a jaunt. "When our father died," he said, "she single-handedly raised us, did for us, taught us, shaped us into what we are today, and after all this *we* have to sign for *her*. How demeaning!"

At the King Saud College for Women, Jodi and I listened to a cracking good debate:

"Islam never said that women should not be educated. The Koran says learning is incumbent upon male and female."

"But what does one do about educated women here whose only concern is children, the soap opera, the fat in the diet?"

"Well, I am educated and can give the best of both worlds."

"And I don't like the condescending attitude of some who say, 'You poor women here, you can't drive; you poor women, you can't talk to a man; you poor this or that.' I wouldn't change for millions, and who asked them? It's my world and I accept it."

"Well yes, but in our society we *do* have some things that need to be changed and others, like driving, that we'd enjoy but that are not the most important things in life. And I can wait until society is ready. It is a part of our life that change is coming. It might take longer, it might take shorter, but we are hoping for the best for our society, within our religion, within our morals, within our readiness to foresee and digest change. Because then it will be for the better."

Inshallah. □

# TITANIC

## Epilogue for

By ROBERT D. BALLARD

WOODS HOLE OCEANOGRAPHIC INSTITUTION



LIKE SOME ghostly Flying Dutchman, R. M. S. *Titanic* (above) seems forever to steam across the ocean floor in this dramatic painting by Ken Marschall. Lost in the North Atlantic after collision with an iceberg on April 14, 1912, the fabled luxury liner sank in 13,000 feet of water with a loss of more than 1,500 lives.

Here in abyssal darkness the ship's rust-streaked bow

stands silhouetted by a halo of artificial light from our manned submersible, *Alvin*. The sub's tethered robot, the "swimming eyeball" *Jason Jr.*, trains its floodlights and video camera on the ship's massive starboard anchor.

We found *Titanic* in the summer of 1985 and explored her more thoroughly the following year.\*

In all we took more than 70,000 still photographs of the

ocean floor that included the parted bow and stern sections with our towed camera sled, dubbed ANGUS. The artist studied the photographs to produce the accompanying illustrations. Later 108 images were painstakingly assembled over many months to create the startling mosaic at right.

Taking those pictures was like playing a vast three-dimensional game of Pac-Man blindfolded. ANGUS, tied by cable to our research ship, was trolled back and forth night after night just above *Titanic*. The sled's three still cameras operated continuously, but no video cameras helped the operators on the surface guide it through what we feared would be an unseen maze of rigging, masts, and debris.

The mosaic was produced by NATIONAL GEOGRAPHIC in collaboration with Madison Press Books. Technician John Porteous at Woods Hole Oceanographic Institution made an initial selection of images. Graphics specialists Serge Martinot and Leo Chapman of Dodge Color, Inc., in Washington, D. C., matched the final selections precisely, with adjustments for angle, perspective, and even variations in depth. In one case where ANGUS missed a section, a video frame was substituted. Only two small pieces (dashed lines) are missing.

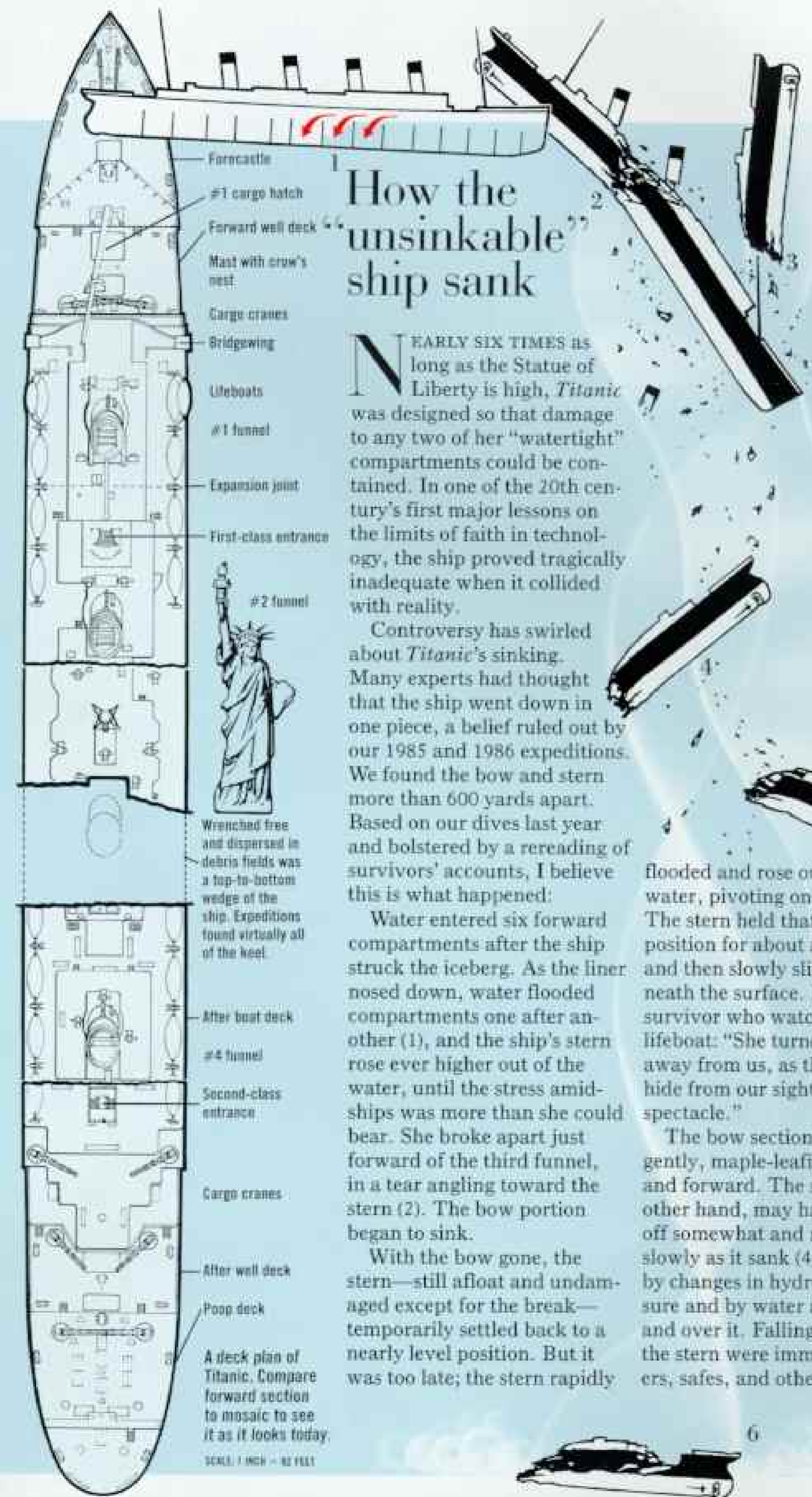
\*See NATIONAL GEOGRAPHIC, December 1985 and December 1986.



Mosaic of a lost giant combines  
108 separate photographs in a historic  
portrait—the first complete view of *Titanic's*  
450-foot shattered forward section.







## How the "unsinkable" ship sank

N EARLY SIX TIMES AS long as the Statue of Liberty is high, *Titanic* was designed so that damage to any two of her "watertight" compartments could be contained. In one of the 20th century's first major lessons on the limits of faith in technology, the ship proved tragically inadequate when it collided with reality.

Controversy has swirled about *Titanic's* sinking. Many experts had thought that the ship went down in one piece, a belief ruled out by our 1985 and 1986 expeditions. We found the bow and stern more than 600 yards apart. Based on our dives last year and bolstered by a rereading of survivors' accounts, I believe this is what happened:

Water entered six forward compartments after the ship struck the iceberg. As the liner nosed down, water flooded compartments one after another (1), and the ship's stern rose ever higher out of the water, until the stress amidships was more than she could bear. She broke apart just forward of the third funnel, in a tear angling toward the stern (2). The bow portion began to sink.

With the bow gone, the stern—still afloat and undamaged except for the break—temporarily settled back to a nearly level position. But it was too late; the stern rapidly

flooded and rose out of the water, pivoting on the surface. The stern held that vertical position for about a minute (3), and then slowly slipped beneath the surface. Recalled a survivor who watched from a lifeboat: "She turned her deck away from us, as though to hide from our sight the awful spectacle."

The bow section sank gently, maple-leaving down and forward. The stern, on the other hand, may have leveled off somewhat and rotated slowly as it sank (4), wracked by changes in hydrostatic pressure and by water rushing in and over it. Falling along with the stern were immense boilers, safes, and other heavy

debris that ended up near it on the ocean floor.

Upon reaching the bottom, the bow (5) plowed into the mud, knifing its way in at a shallow angle. The stern's impact was more traumatic; when it hit bottom (6), it buried itself some 45 to 50 feet, over its propellers, crumpling the steel plating on the hull. In short, the bow landed, the stern crashed.

More than two and a half hours elapsed between the time *Titanic* hit the iceberg and the moment she vanished. Those among her passengers and crew members who could not make it into lifeboats had time to move aft as the bow sank. When the stern went down, most on board fell to the water. John B. Thayer, Jr., who survived, said their cries swelled into "one long continuous wailing chant... like locusts on a mid-

summer night in the woods in Pennsylvania." It lasted 20 or 30 minutes before finally dying away.

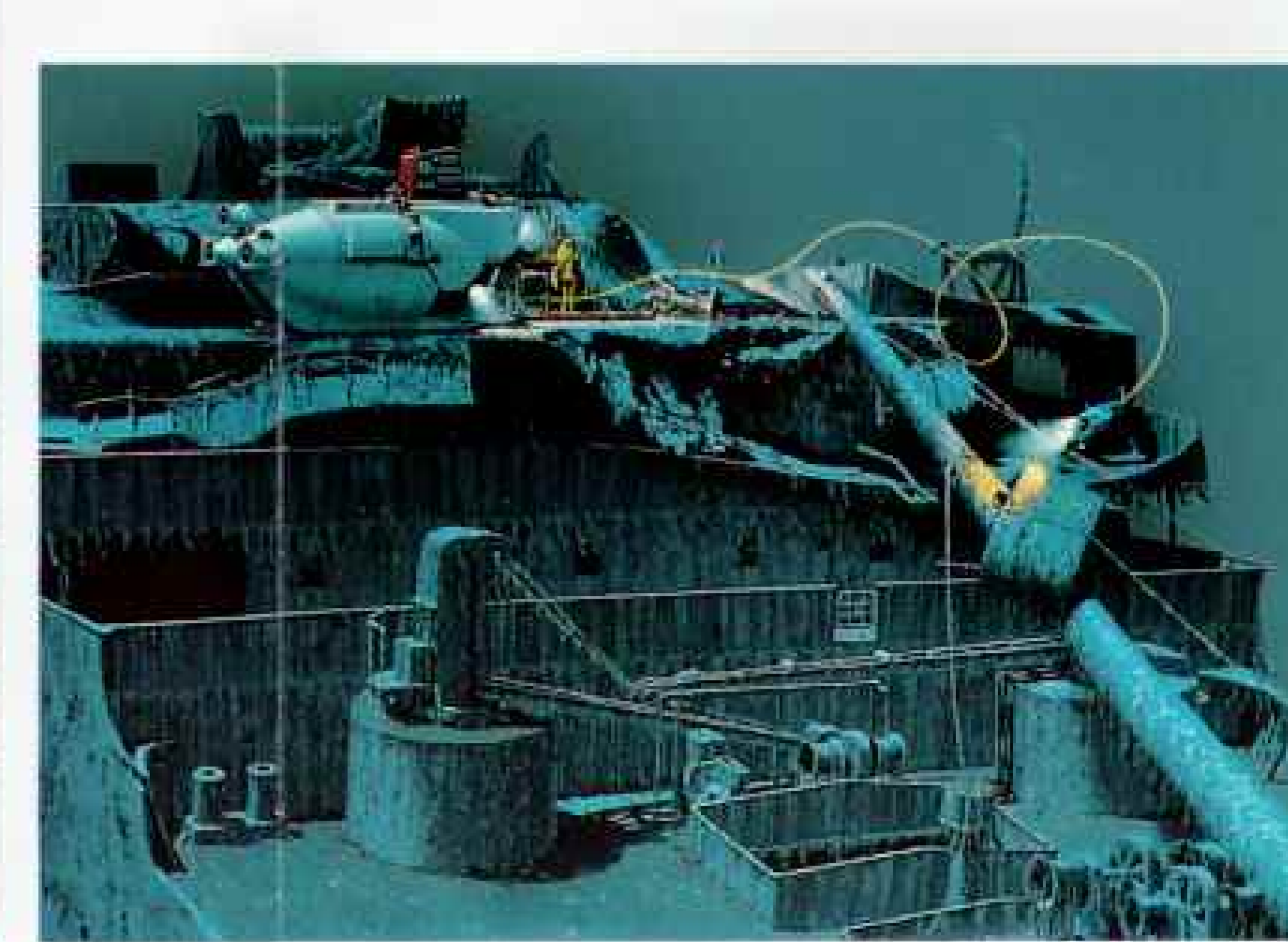
Dr. Robert D. Ballard's new book, *The Discovery of the TITANIC*, produced by Madison Press Books, is available this fall from Warner Books in the United States, Viking-Penguin in Canada, and Hodder & Stoughton in Great Britain. The paintings by Ken Marschall in this article and the photograph on page 463 are from the book.

PLAN VIEW OF TITANIC BY RICHARD SCHLECHT. DIAGRAM BY WILLIAM H. BURR, NATIONAL GEOGRAPHIC ARTIST, BASED ON A RENDERING © KEN MARSHALL

THREE PAINTINGS by Ken Marschall, longtime student of *Titanic*, at right and below, capture the terrible carnage at *Titanic's* final resting-place. Despite its massive impact with the ocean floor, the ship's bow section (right), some 450 feet of her total 882-foot length, still retains its shape and majesty.

As the section bulldozed its way into the mud, it buckled. The after part jackknifed, and the decks collapsed like an accordion at their weakest point, between number two and number three funnels. The third funnel's empty base appears at the extreme aft edge of the section.

Exploring two areas of the ship most closely linked with her death,



*Alvin* (left) rests on the stern, while *Jason Jr.* inspects the crow's nest on the toppled foremast. It was from here that lookout Frederick Fleet first spied the iceberg and telephoned the bridge, "Iceberg right ahead!" But it was already too late. Within seconds the ship's starboard side brushed against the berg, and thus began a night of terror.

In contrast to the bow section *Titanic's* mangled stern, surrounded by its own debris (below left), looks as though it had been alternately torpedoed, bombed, and shelled. The aftermast, snapped at the base, droops forlornly over the rail like a broken cargo boom. Fixtures wrenched from the tortured hull include three cannon-shaped cargo cranes at left and one of the ship's safes at center. At far right *Alvin* inspects the ship's rudder, searching for her propellers.

ONE OF THE MOST poignant of all images taken by ANGUS is that of a pair of boots (right), resting on the seafloor at such an angle that it is probable that the owner sank to the bottom while still wearing them. Deep-sea scavengers soon disposed of the human remains, but the boots proved inedible. The hostile environment and the tannic acid used to preserve leather on land kept them intact underwater.

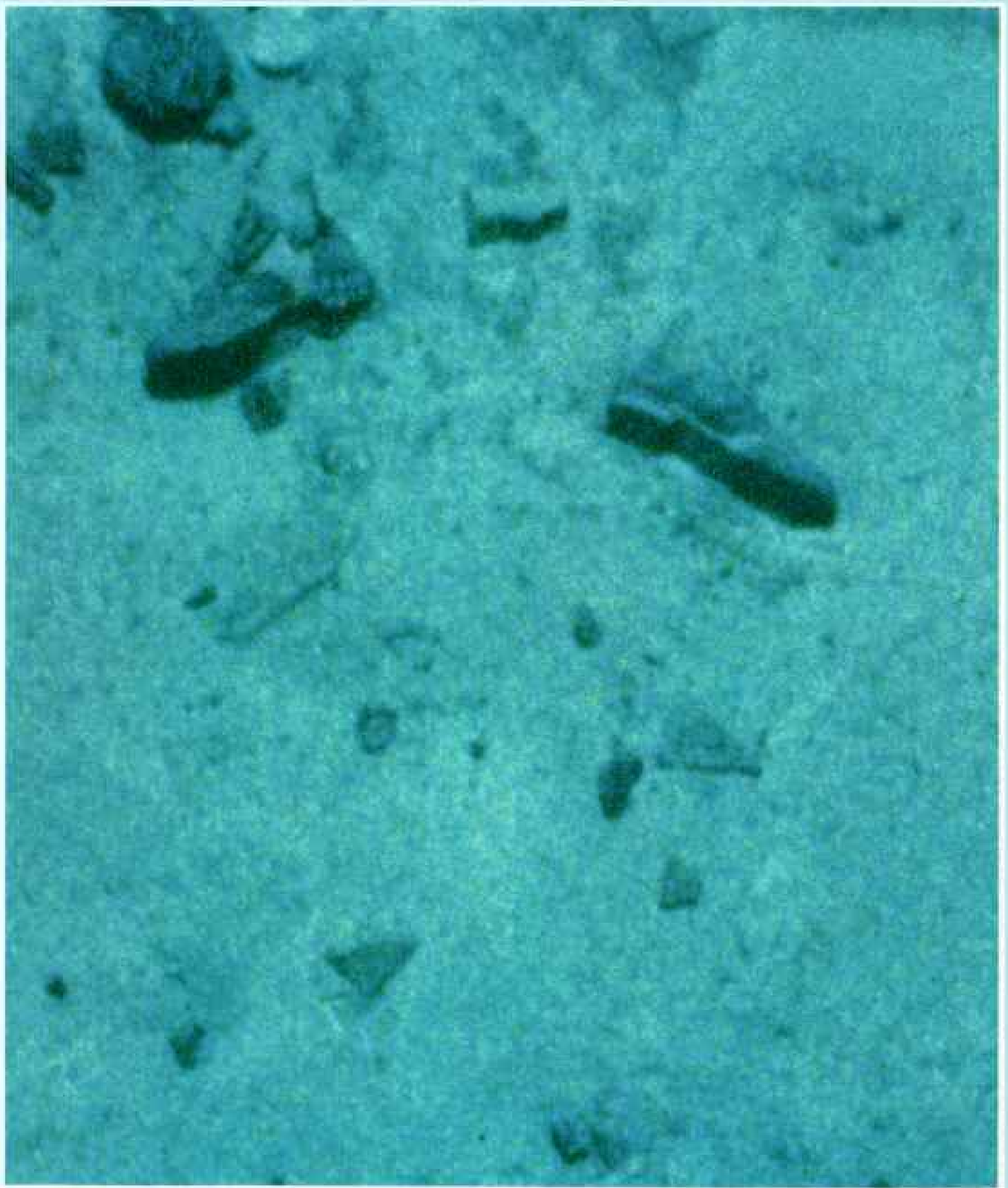
Who was the owner of the boots—a passenger, a crew member, young or old? A wealthy man or a poor immigrant? We can speculate, but, as with so many of *Titanic's* mysteries, we shall never know.

Looking at such photographs long after I left *Titanic's* resting-place, I became more convinced than ever that it would be wrong to attempt recovery of any of the remains. A photograph like this is more powerful than the recovery of a single shoe; it is a statement in itself, a statement that describes a tragic, frozen moment in time.

But more than anything else, *Titanic's* grave is, as these shoes demonstrate, hallowed ground.







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## R.M.S. TITANIC

Sailed: April 10, 1912 Sank: April 15, 1912 Found: September 1, 1985

Robert Ballard's hope that *Titanic* should remain undisturbed was not realized. Last July, a French expedition began to retrieve artifacts from the wreck site. Its actions were roundly criticized as grave robbing—justifiably, for the line between curiosity and acquisitiveness seems to have been crossed. □

—THE EDITOR

# "DOC" EDGERTON THE MAN WHO MADE TIME STAND STILL

By ERLA ZWINGLE

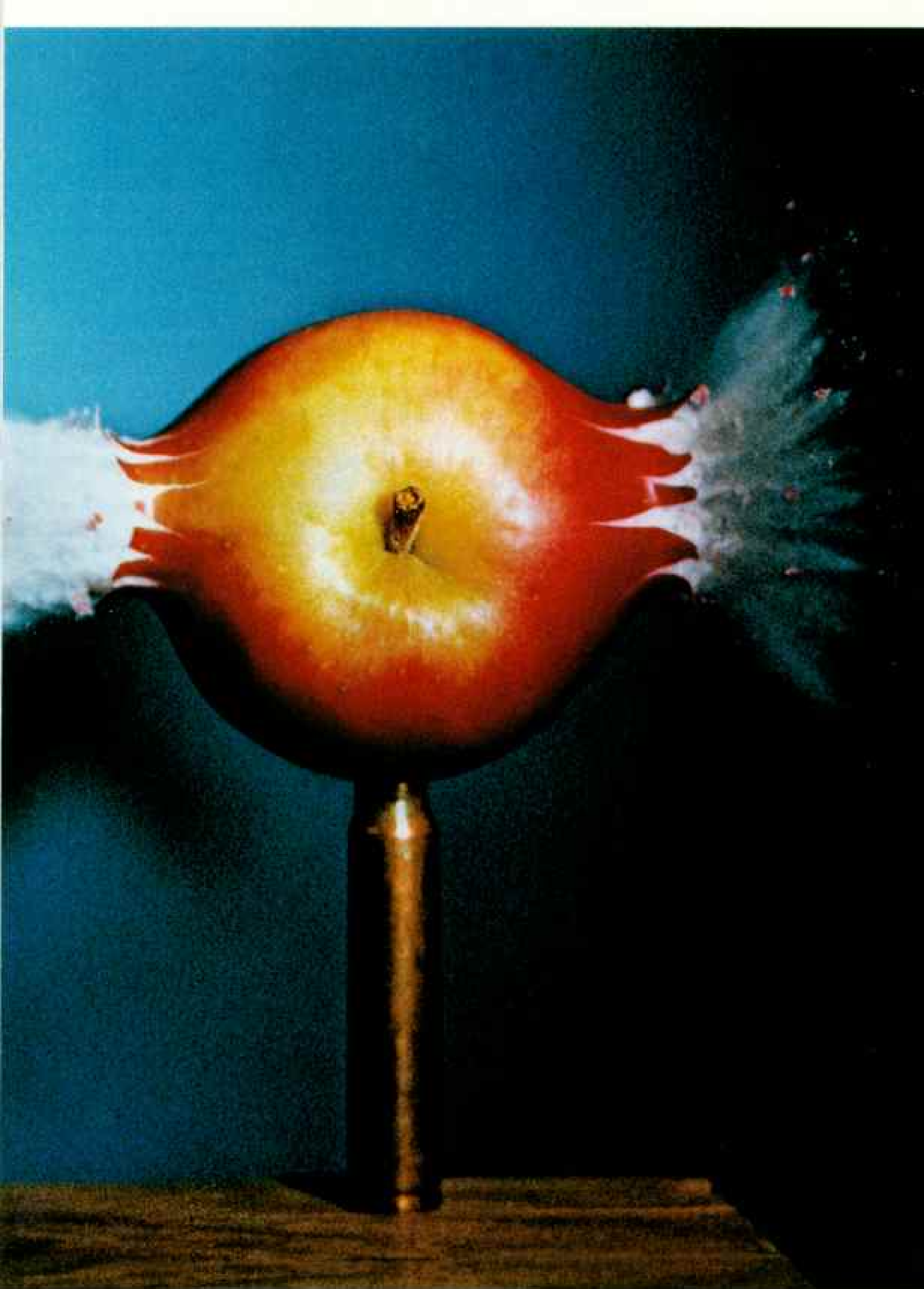
Photographs by HAROLD E. EDGERTON  
and BRUCE DALE  
NATIONAL GEOGRAPHIC PHOTOGRAPHER



BRUCE DALE (BOVET); HAROLD E. EDGERTON

Father of high-speed photography, Dr. Harold E. Edgerton has pioneered the use of stroboscopic light to freeze on film movements invisible to the naked eye. Here a bullet pierces an apple at 1,900 mph.







**O**N AN AUTUMN DAY in 1927 Harold E. Edgerton made time stand still. This had not been his intention. As a 24-year-old graduate student in electrical engineering at the Massachusetts Institute of Technology, he was conducting an experiment in power-system stability, the ability of synchronous motors and generators to stay in step after a sudden disturbance—such as lightning hitting transmission lines. Having worked as a lineman for the Nebraska Light and Power Company, he understood that this was far from a theoretical problem.

Edgerton was interested in determining how the parts of a certain kind of motor were affected by a sudden shift in power. While simulating such a disturbance, he used a mercury-arc rectifier, which not only converted the motor's current from alternating

to direct but also sent a power surge to the generator. In the process the rectifier produced a brilliant flashing light.

Edgerton noticed that the flashes coincided perfectly with the motor's rate of rotation, lighting the same part in the same position at each turn. Suddenly the moving parts appeared stationary, a familiar illusion to anyone who has seen a movie in which a wagon wheel in motion looks as if it's standing still.

Happily, Edgerton could now study the motor's problems while it was in operation. Even better, he quickly realized, the flashing light could free the human eye from its inherent slowness of perception, illuminating a universe of motion previously only surmised. Edgerton adopted an old name for his lamp, the stroboscope or strobe, and immediately got busy considering how else his

"magic lamp" might prove useful. This pursuit has profoundly changed the way we see the world.

The principle of the strobe had been known for nearly a century, and a few primitive devices had been constructed, but lacking a purpose they had remained laboratory curiosities. Almost immediately he decided to link the strobe to a camera in order to study this new universe more conveniently. Although even today the shutters of most cameras in use can't open and close reliably any faster than  $\frac{1}{1000}$  of a second, Edgerton understood that his new light could act as the shutter. He passed a current of electricity

through a glass vacuum tube filled with xenon gas, and the result was a brilliant, rapid flash whose duration he could accurately predict.

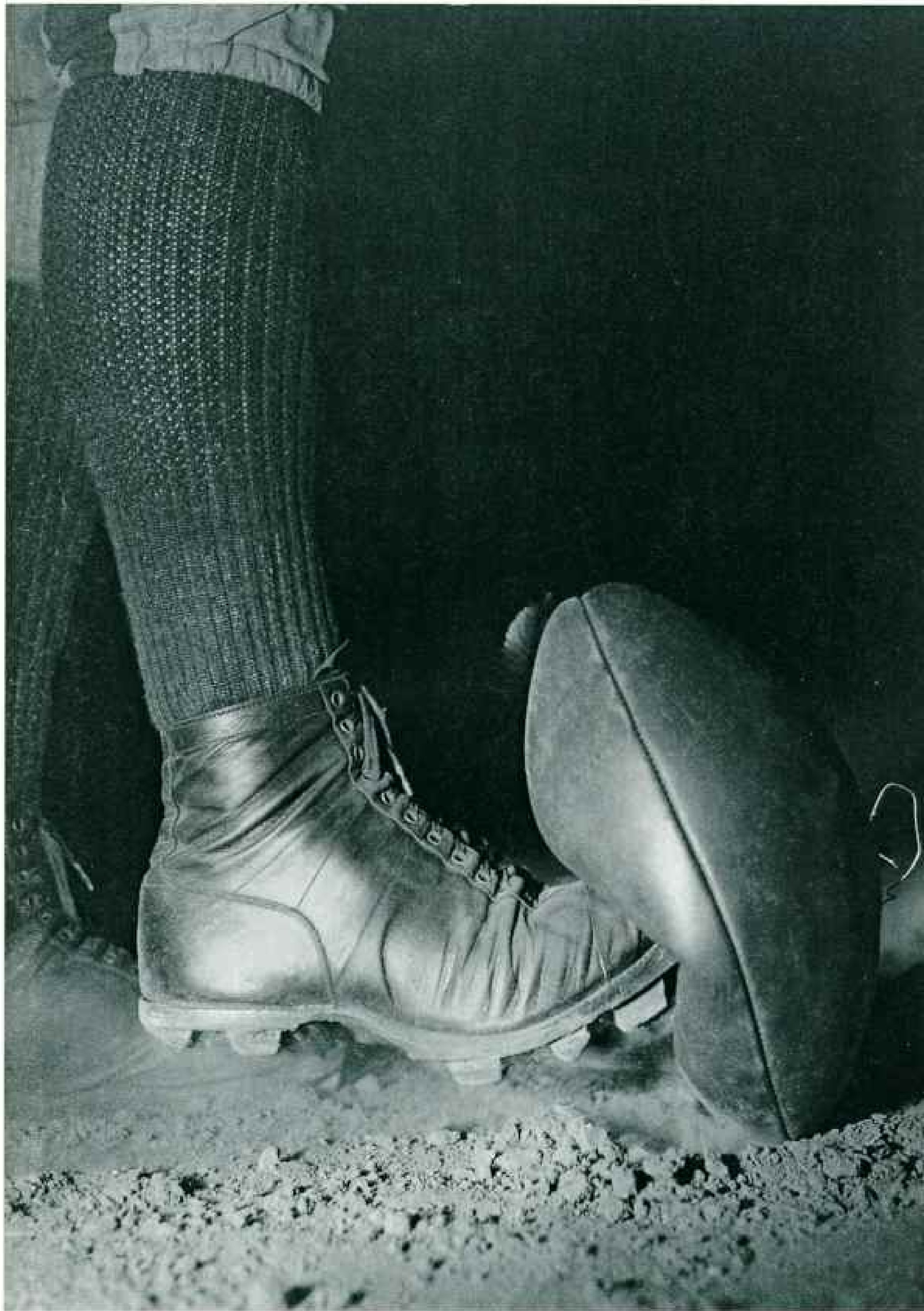
The resulting photographs have become classics: the elegant coronet of a splashing drop of milk, the perfect parabola of a tossed tennis ball, the pinwheel progress of a diver toward the water. The public was amazed by their novelty, the art world intrigued by their beauty.

Scientists recognized that they had gained

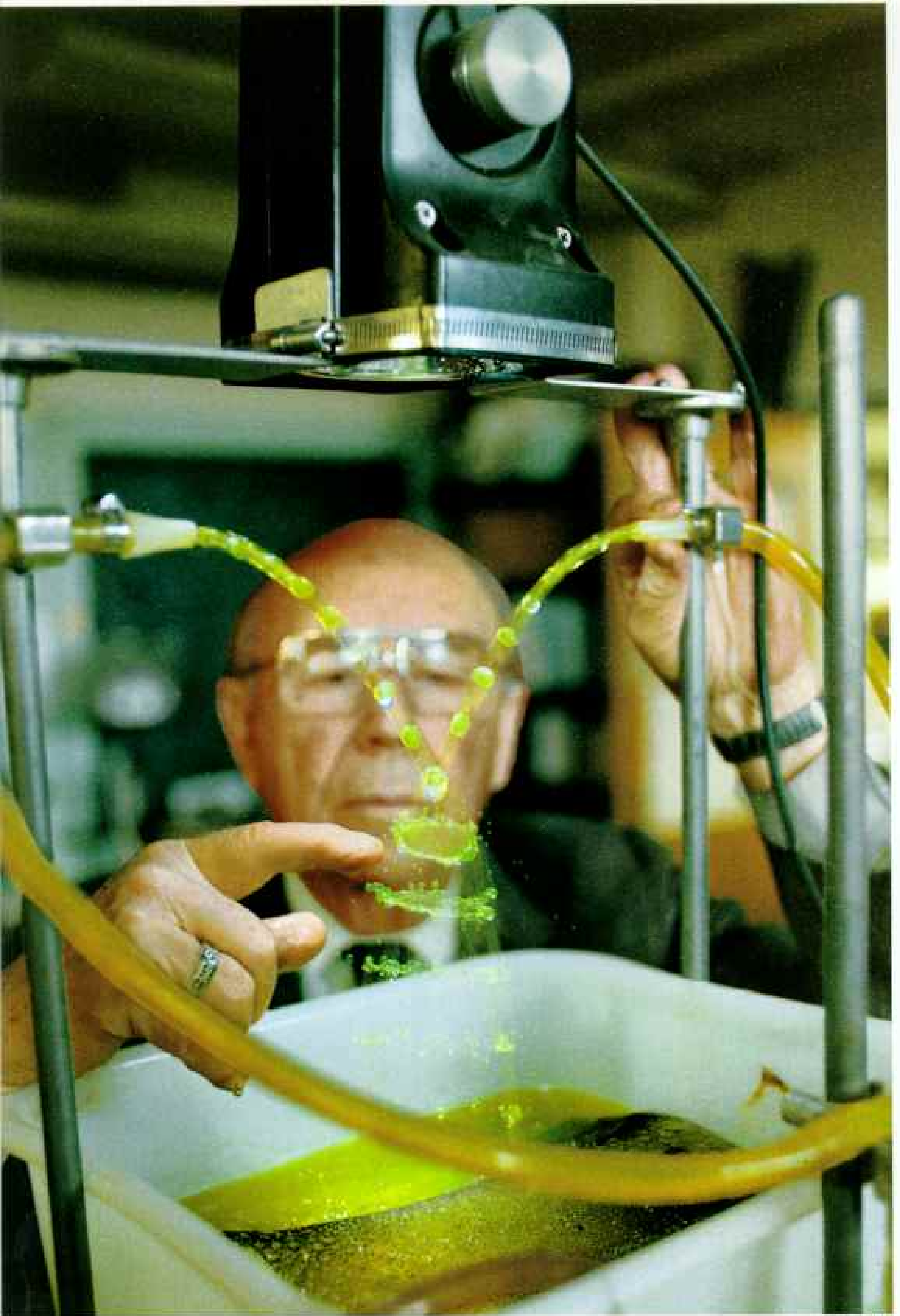


HAROLD E. EDGERTON COLLECTION (LEFT); HAROLD E. EDGERTON

*Permanent fixture at the Massachusetts Institute of Technology for more than 60 years, "Doc" Edgerton technically retired in 1968. At 84 he continues to teach and hold court, however, in his crowded lab, which has hardly changed since this 1942 photograph (above). In 1934 Edgerton caught the split-second moment of impact as football player Wes Fesler kicked the ball (right), leaving behind a small puff of dust from the ball's seam. A wire at right triggered the flash.*



*"Doc" Edgerton—The Man Who Made Time Stand Still*



BRUCE DALE

an extraordinary new tool with which to study the inner workings of their particular disciplines. Edgerton photographed the hatching of shrimp, the heat of a candle flame, the patterns of shattering glass. Who could have guessed that a cat laps milk with the underside of its tongue? Or that bats sometimes catch their prey with their tail membranes? Harold Edgerton's magic lamp had enabled us, as he put it, "to chop up time into little bits and freeze it so that it suits our needs and wishes."

In the six decades since that epiphany, Edgerton has remained at MIT, putting his discovery to a remarkable array of uses. He has devised special lights for underwater photography. ("He gave me sunlight to put under the sea," says photographer David Doubilet.) He has contrived lights for nighttime aerial-reconnaissance photography, for which he was recognized as having substantially contributed to the success of the Normandy invasion. Edgerton has collaborated with Jacques-Yves Cousteau (whose crew dubbed him "Papa Flash") and many others in underwater archaeology, from the

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Erla Zwingle, a writer and editor who lives in Manhattan, has contributed articles on Australia's Tea and Sugar Train and New York Harbor to the GEOGRAPHIC.

expedition that located the wreck of the Civil War ironclad gunboat *Monitor* to a summer stakeout of the Loch Ness monster.

Far from lounging on his laurels, Edgerton has followed a network of interconnecting side roads to numerous ancillary enterprises: devising more powerful and accurate systems of sonar; founding, with two partners, a major corporation (EG&G) to develop sophisticated electronic technology; helping to establish the New England Aquarium, whose fifth floor is the Harold E. Edgerton Research Laboratory.

He also contributed funds and expertise to the Sea Grant Program at MIT; its oceanographic research vessel *Edgerton* was named in his honor. His interest in ultrahigh-speed photography and cinematography took him to Hollywood, where his film *Quicker 'n a Wink* won an Oscar in 1940. Awards have proliferated, from the Medal of Freedom to the medallion of the National Inventors Hall of Fame.

When all his patents are tallied (40 plus, including those he holds with associates), he occasionally finds himself compared to Thomas Edison. Edgerton has become a wealthy man, he is a legendary teacher, and he seems to be one of those rare souls who is loved as deeply as he is admired. At age 84 he still describes himself simply as an electrical

*Lightning bolts in miniature are made to order by the subtle circuitry of the strobe light (right). Battery 1 supplies power (via resistors 2 and 3) to two capacitors (4 and 5) that store large charges for instantaneous release. When the switch 6 is closed by the camera's shutter, current flows from capacitor 4 through the transformer 7. This generates high voltage in a coil wrapped around the flash tube 8, exciting the xenon atoms within. These atoms then form a path between electrodes 9 and 10, allowing the charge built up in capacitor 5 to leap the length of the tube. For the briefest part of a second, the xenon atoms fluoresce brilliantly. The carefully synchronized stroboscopic light on Edgerton's Hydraulic Happening Machine (left) reveals the individual drops—invisible in ordinary light—that make up the flow of water.*

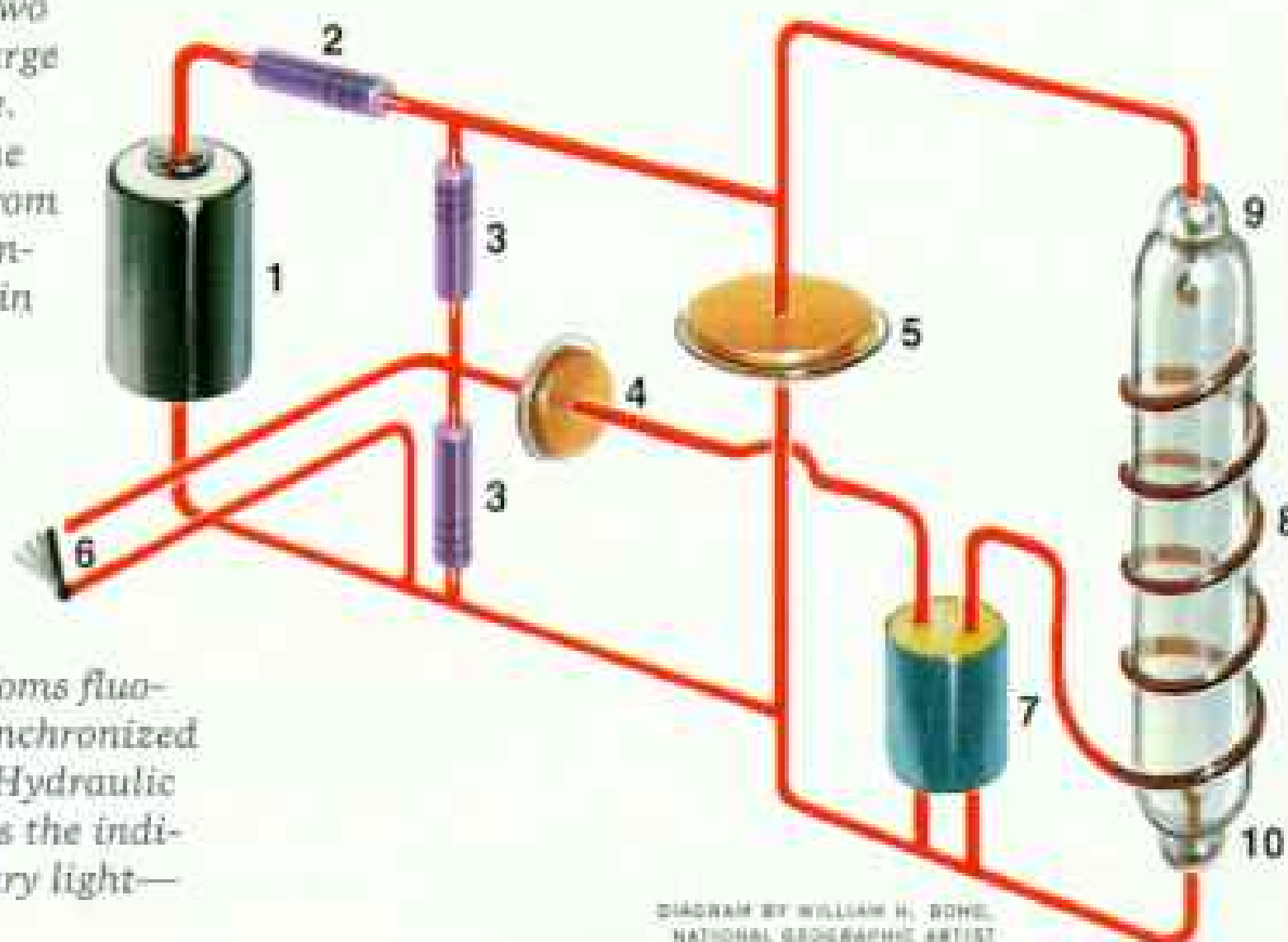
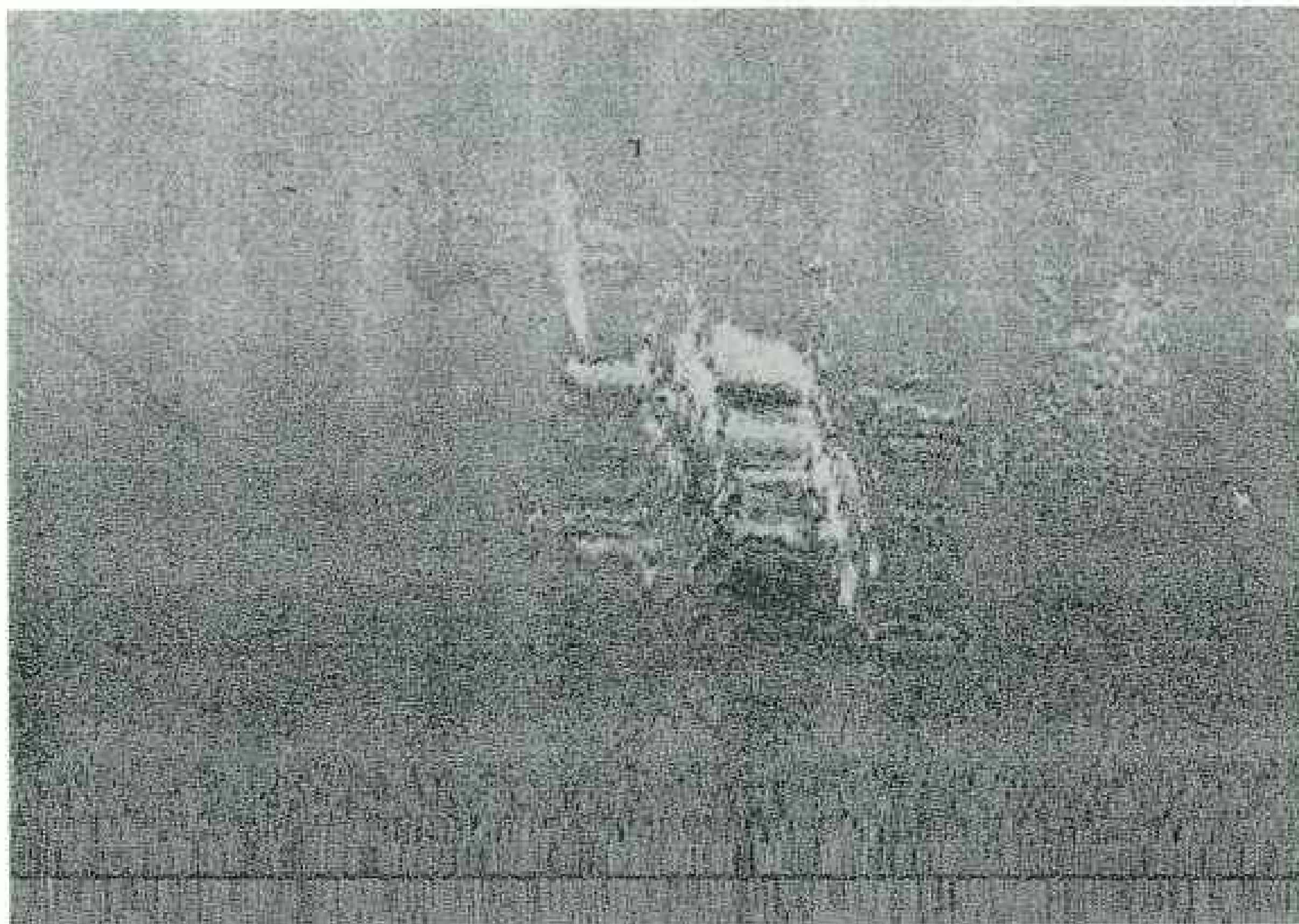
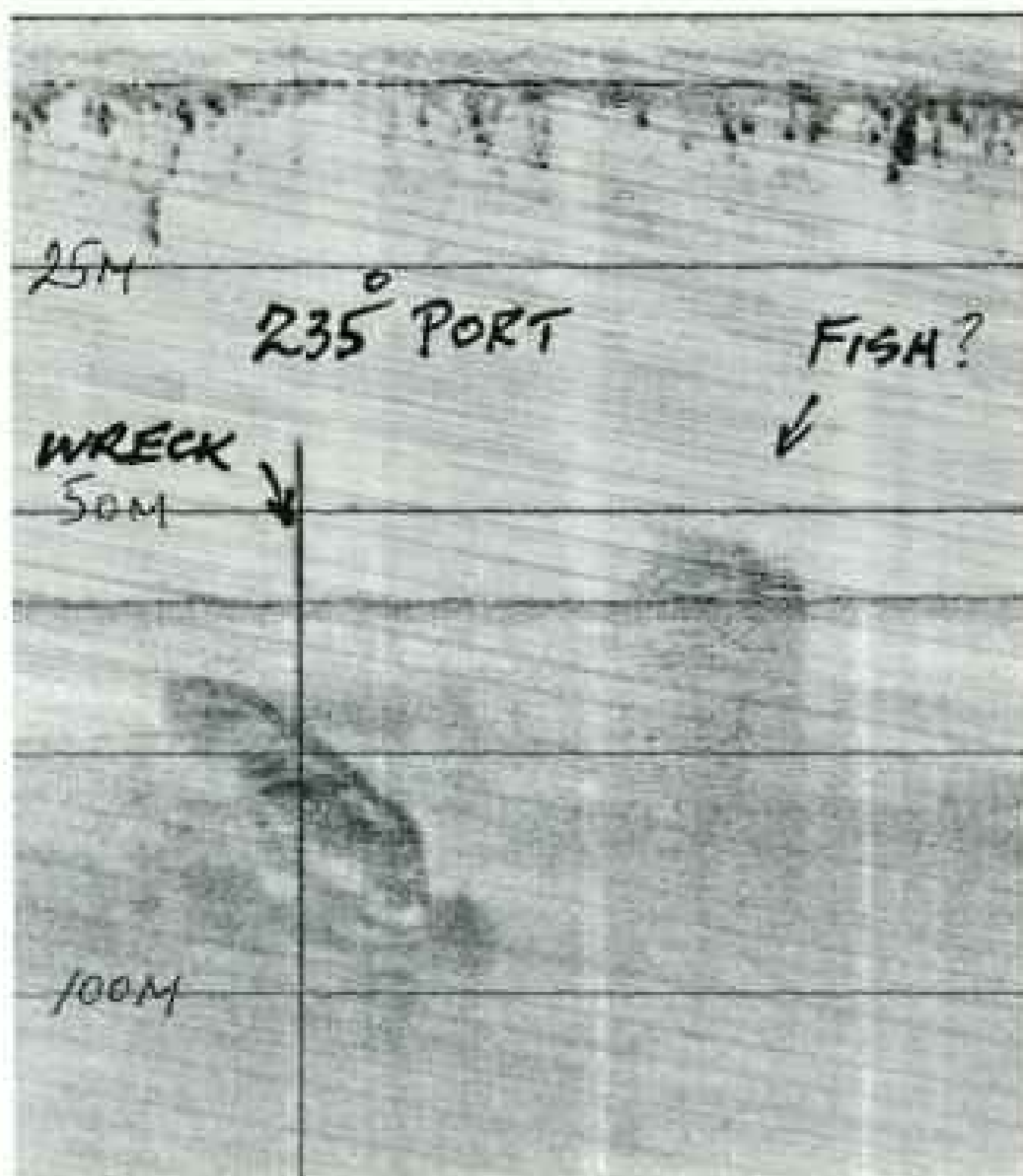


DIAGRAM BY WILLIAM H. BOND,  
NATIONAL GEOGRAPHIC ARTIST

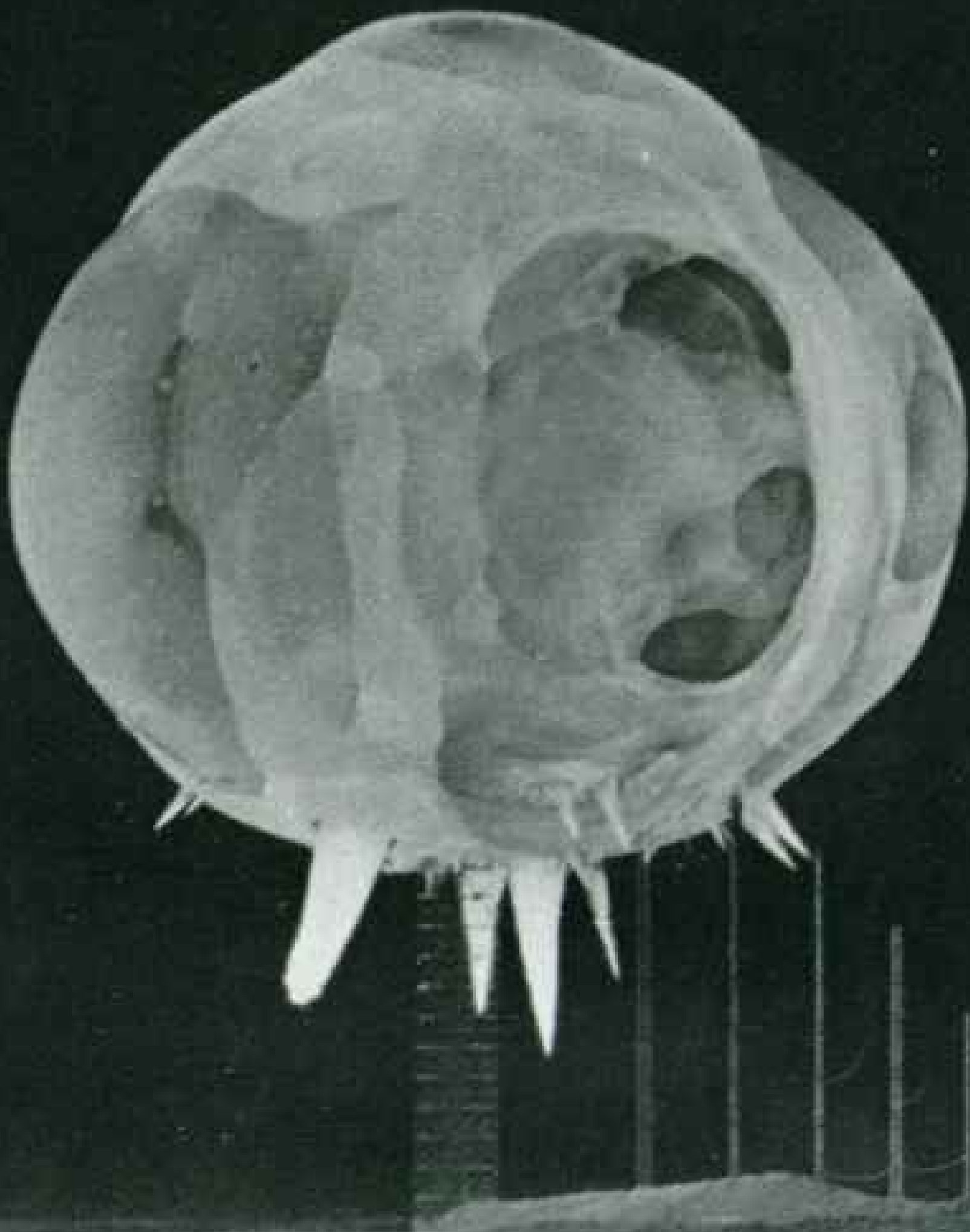


Sailing the seas in search of wrecks, Edgerton (facing page) has combed the seafloor with cameras, stroboscopic lights, and, more recently, side-scan sonar—a sophisticated acoustic device that provides underwater "sound pictures" of the ocean floor. The technique was refined for commercial use in the 1960s by the company Edgerton founded, EG&G. In 1973 a side-scan sonar printout aboard the research vessel *Eastward* revealed a promising image (right) off North Carolina's Cape Hatteras. After Edgerton and his crew lowered cameras into the ocean, their hopes were confirmed: Buried for more than a century, there lay the wreck of the Civil War ironclad *U.S.S. Monitor*. On March 7, 1986, EG&G sonar equipment produced an image (below) off the Florida coast that proved to be the crew cabin remains of NASA's ill-fated *Challenger* shuttle.



HAROLD G. EDGERTON (TOP); OREGON/NASA (ARROW); DAVID DOUBILET





U. S. DEPARTMENT OF ENERGY (ABOVE); U. S. ARMY; HAROLD E. ROBERTSON COLLECTION

engineer, answers cheerfully to "Doc," and is still up to his earlobes in work.

On days when Edgerton is not working elsewhere—Woods Hole, say, or Cuba—or writing books and articles, or conducting seminars, or helping students with their projects, he can be found at MIT in "Strobe Alley." This stretch of fourth-floor hallway has been dedicated as a sort of museum of Doc's exploits. The corridor is lined with glass cases containing an assortment of citations, encrusted artifacts from underwater expeditions, and various seminal photographs. In one, hung near the stairwell, a king of diamonds waves impassively from a playing card at the bullet that has just shot through his midriff. ("If you just photograph the bullet, people say, 'How did you hang it up there? Where's the string?'" he explains. He has also assassinated apples, light bulbs, and even copper wire, which reacted in very surprising and instructive ways.)

A clang and a crash resound suddenly from behind the door to room 4-410. A baritone cheer is followed by several youthful giggles. Edgerton has escaped his desk once again, this time to show a troop of

high-school students some of his favorite tricks. "He wants to share the thrill of discovery," says one student, and most visitors quickly find themselves drawn into the lab to witness some marvel. A few students are staring at the "boomer," a sonar device that has just zapped a metal disk into the air. The others are staring at him. "How does it work?" a girl asks timidly. "It's magic, honey!" he cries. "Magic!"

**E**DGERTON is a small, compact man with a slight stoop. The crystal of his ancient Timex is cracked, and his serviceable suit was never fashionable. He has a shrewd glance and an abrupt way of speaking that, without his air of sunny unpretentiousness, could be brusque. "Let's get out of here," he likes to say. "Do something useful for a change." The gruffness is mitigated by an irrepressible sense of humor with a strong vein of self-deprecation.

A nimbus of merriment surrounds his most innocuous remarks. "Read that," he says with a twinkle as he hands an intimidated student his new book on sonar, "and you'll know more than I do." His perpetual

*The coast was clear in Normandy on D day, and, thanks to Edgerton's ingenuity, Allied troops knew they could invade. This historic aerial shot (right), taken before dawn on June 6, 1944, resulted from a system he devised for attaching huge strobe lights to reconnaissance planes to take fleeting, clear pictures of enemy territory. The photograph showed a telling absence of troop movement on major highways, revealing that the Germans were ill prepared for attack.*

*In the early 1950s Edgerton and his colleagues at EG&G developed a magneto-optic shutter capable of recording the fireball of an atomic bomb (left) at exposures as short as a hundred-millionth of a second.*





*The full swing of a golfer is seen in segments recorded by the multiple flashes—one hundred per second—of Edgerton's strobe. After hitting the ball, the club can be seen to have lost momentum. Since the elapsed time between each flash is known, the club's changing velocity can be calculated.*

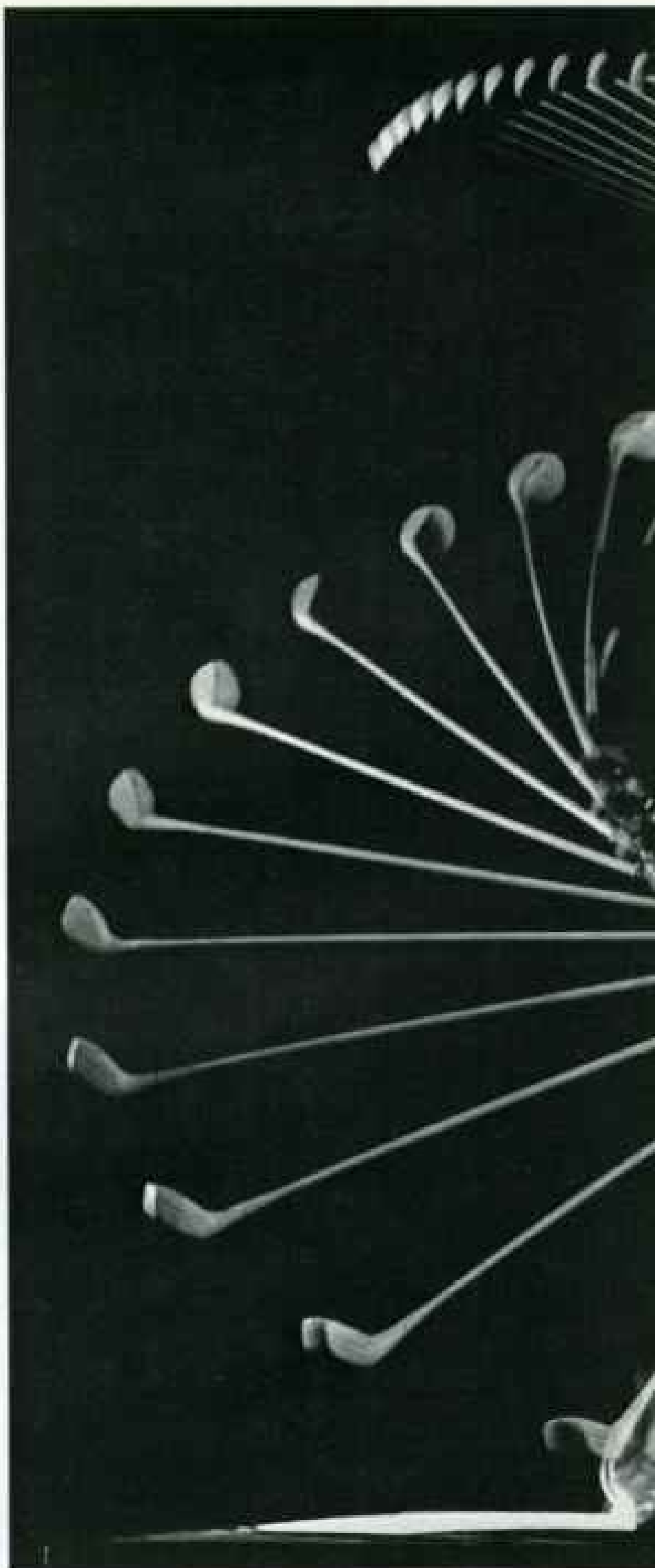
gleam of amusement accounts for much of the charm he has exerted on generations of students and colleagues. On the way to lunch he nonchalantly sidesaddles down the banister, losing his balance halfway down. "I used to be able to make it all the way to the bottom," he says.

Doc gives the impression of being a simple soul, the old company professor. "But he can really cut through and get to the heart of a problem," says longtime colleague Ed Curley. "It's very, very difficult to fool him." He may enjoy playing the role of faculty eccentric, but Edgerton is taken seriously by his peers because his stunts usually make a point.

There was, for example, the little incident of the nudist colony. Early in World War II, night aerial-reconnaissance photography depended on lighting the picture with flares dropped from the plane. Weather and other factors made this practice undependable. At the request of the U. S. Army Air Corps, Edgerton had developed a strobe package that flashed with nearly a quarter of a million candlepower to photograph enemy territory.

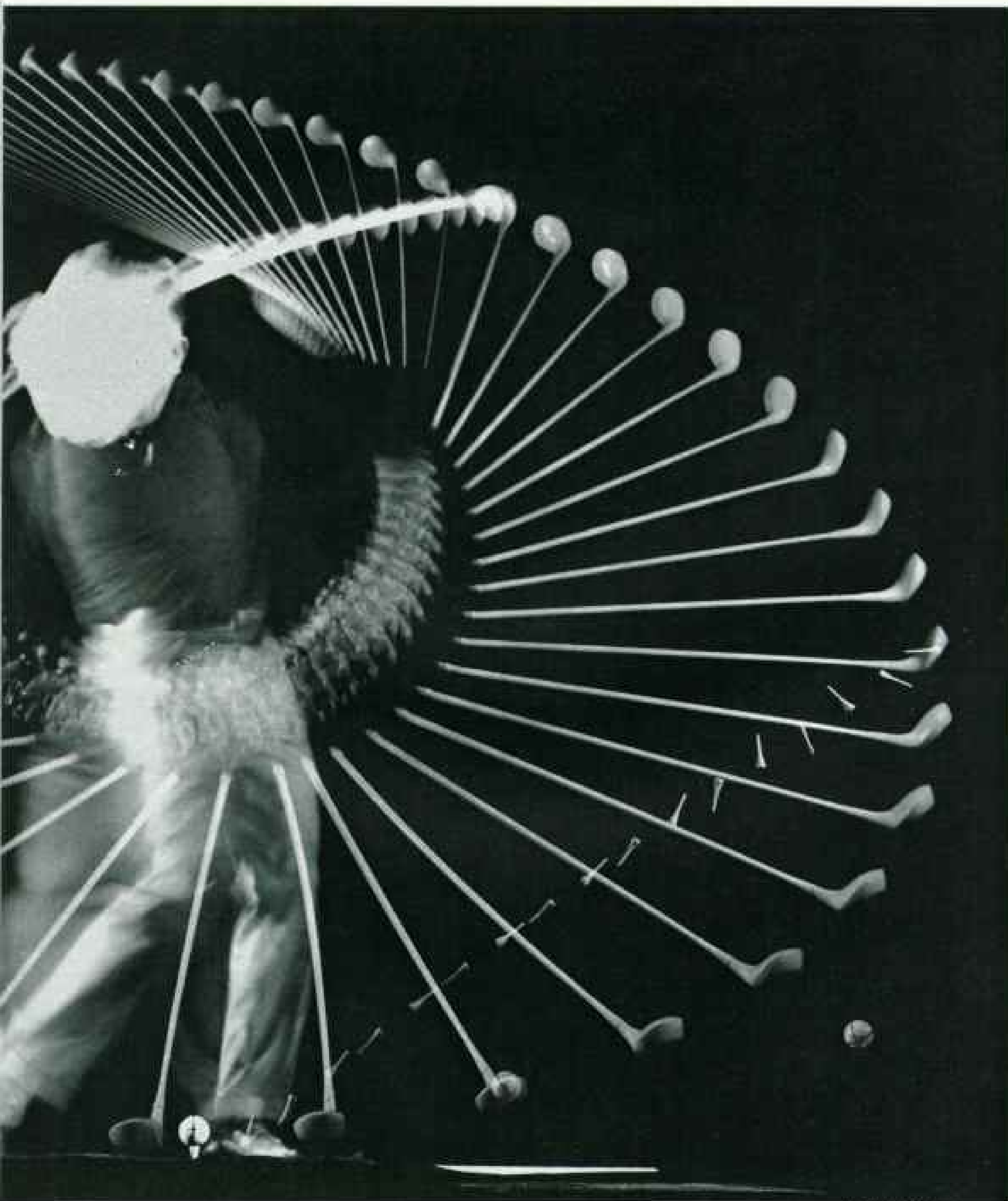
The pilots resisted. They preferred fighting to photographing. So Edgerton obtained (nobody seems to know quite how) the exact coordinates of a British nudist camp and suggested that the pilots try to photograph it. They not only scrambled in record time, but got so close they could discern the message—"REPORTING YOU"—the indignant campers were spelling out with their towels. "I'm a practical guy," Edgerton grins.

**H**AROLD EUGENE EDGERTON was born in Fremont, Nebraska, on April 6, 1903. His father hoped his son would also be a lawyer. "That was not his temperament," says Mary Ellen Pogue, one of his two sisters. "Harold was very handy—he could fix anything," adds Volta Torrey,



who grew up with Edgerton in Aurora, Nebraska.

The Edgertons lived a plain life guided by fundamental values: hard work, honesty, integrity. They attended the First Christian Church almost every week. Edgerton still does not smoke, rarely drinks, and seldom utters an oath stronger than "heck."

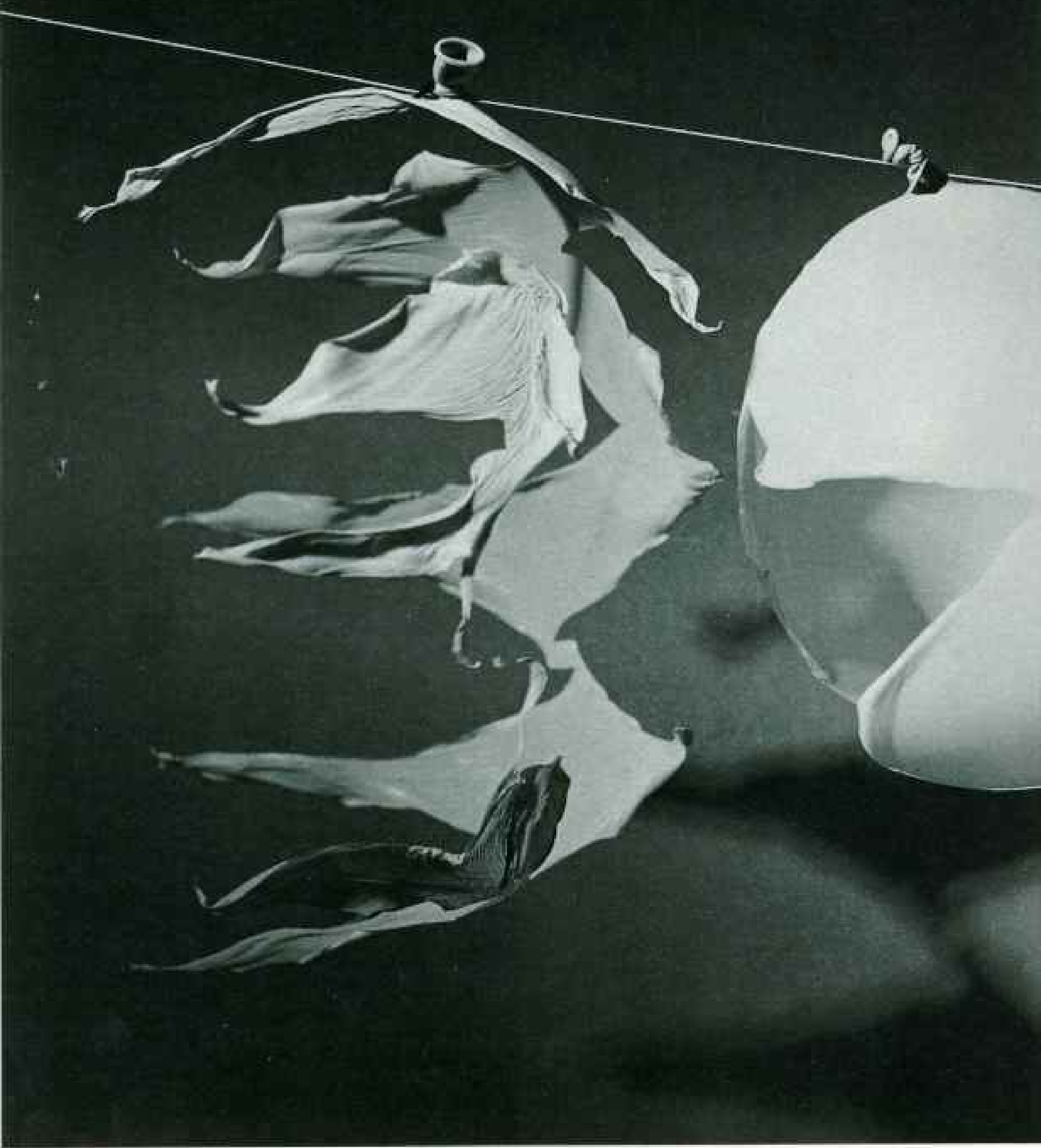


HAROLD E. EDGERTON

"My father told me the salary isn't important," Edgerton recalls. "The thing is that you do the work and you do it satisfactorily. You have to have continuity, persistence. Persistence is a great thing." Some years later, as he shoveled coal into the Nebraska Light and Power Company boilers, he kept his spirits up by envisioning the service he

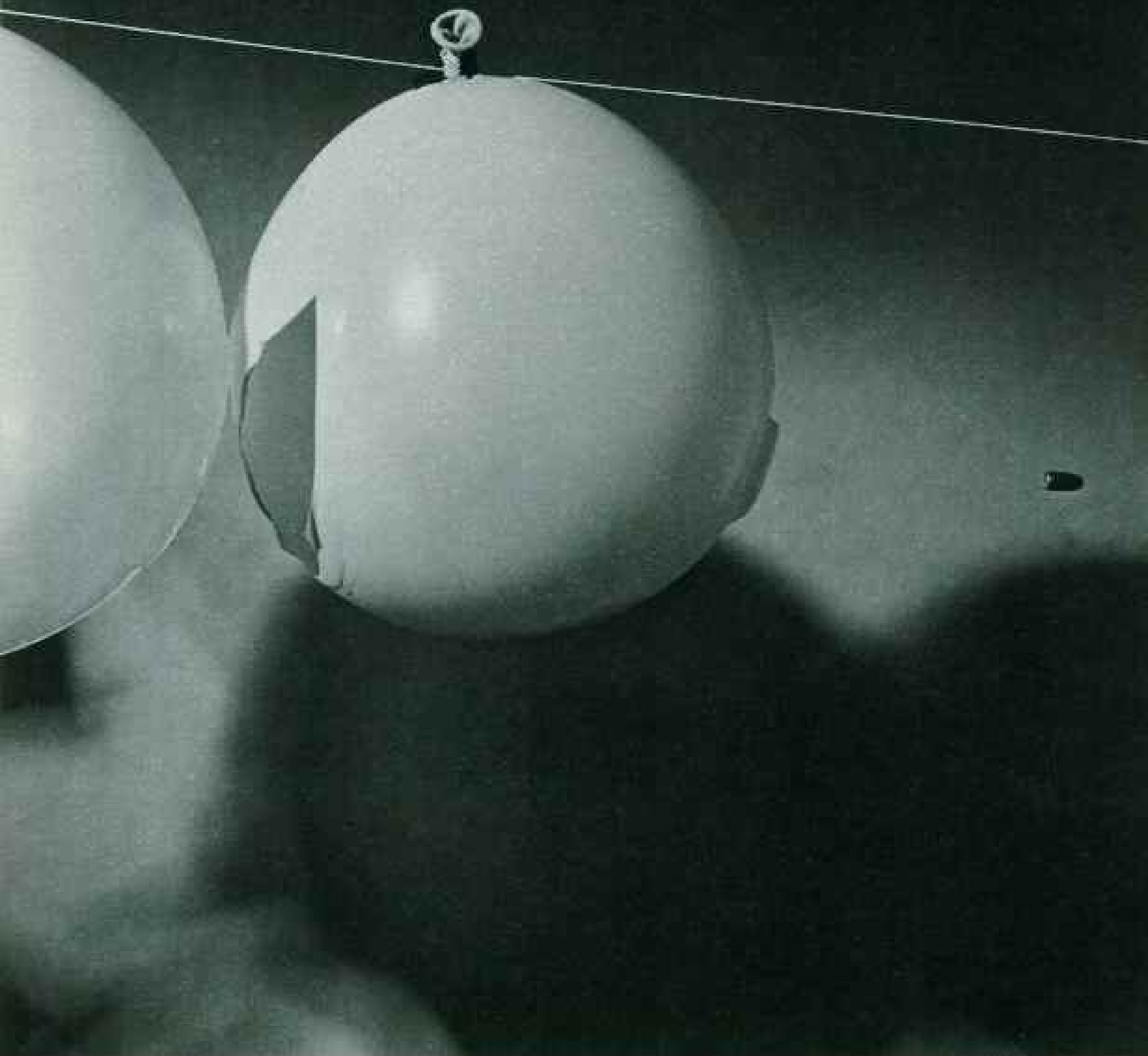
was rendering housewives "who were making doughnuts and ironing their husbands' underwear."

As an undergraduate at the University of Nebraska, Edgerton supplemented his income by working as an electrician, wiring houses and running projectors, then went to work for General Electric in Schenectady,



*Burst by a bullet speeding off to the right, three balloons on a string collapse in stages, frozen by an exposure of a half-millionth of a second. The walls and ceiling of Edgerton's lab bear traces of many similar experiments. Over the years he*

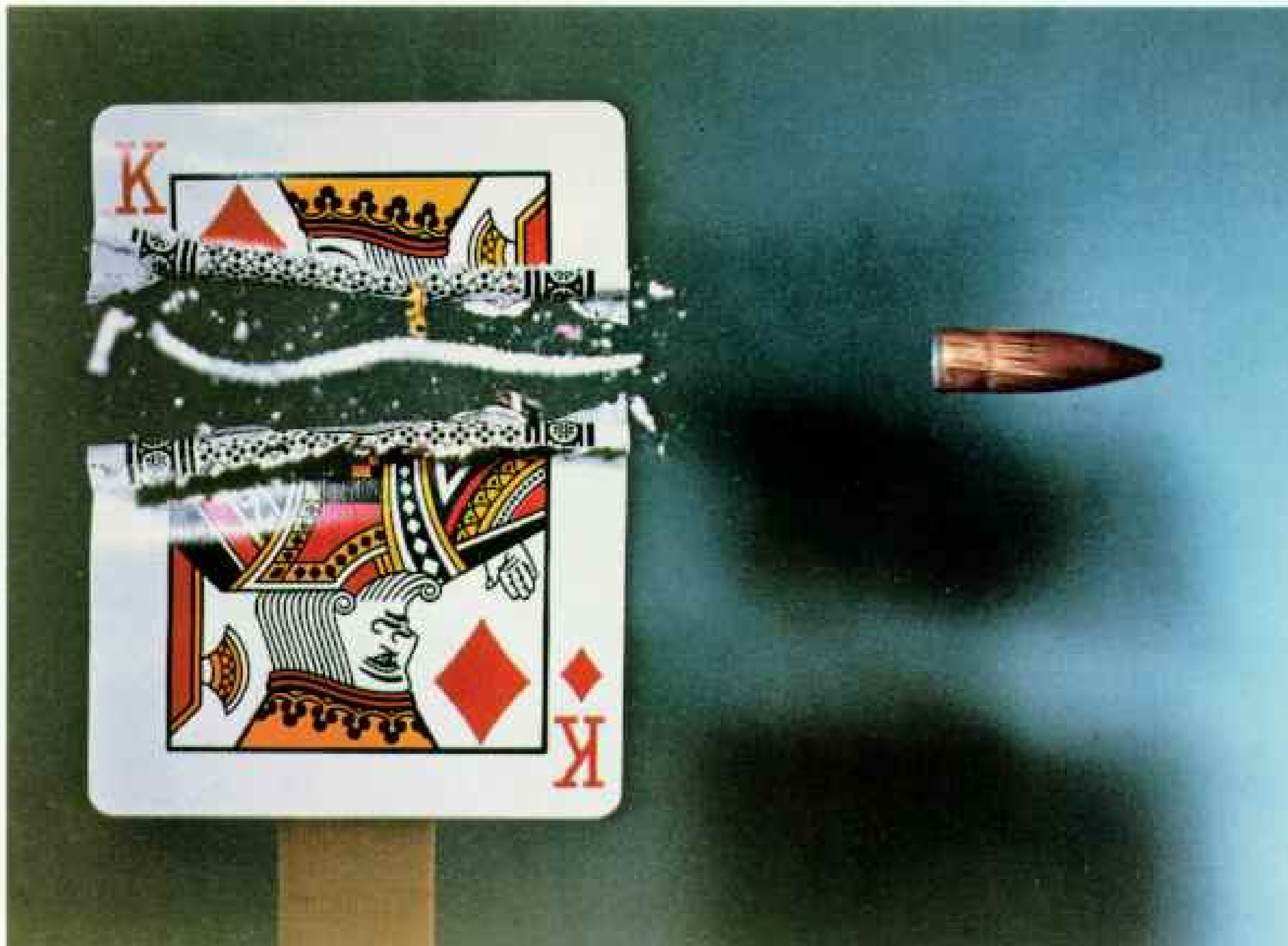




HAROLD E. EDGERTON

*has fired bullets through light bulbs, pieces of chalk, soap bubbles, radishes, and bananas, as well as innumerable apples. Live subjects—shot only with a camera—include hummingbirds, bats, dolphins, dancers, cheerleaders, and acrobats.*





J. KIM VANDIVER AND HAROLD E. EDGERTON (LEFT); HAROLD E. EDGERTON

*Shot through the head, the king of diamonds begins to disintegrate, yet one more target of Edgerton's trigger-happy photography. In 1973 Edgerton and his teaching assistant J. Kim Vandiver created a stroboscopic photograph (left) to show variations in the density of air caused by heat and pressure as a supersonic bullet passes at 1,200 feet per second through hot air above a candle.*

New York, for a year. He returned to Aurora assuming he would work for the power company again, but instead took his father's suggestion that he continue his studies in the East, at the Massachusetts Institute of Technology.

He's still there. He married a Nebraska girl, Esther Garrett, had two sons and a daughter and, so far, seven grandchildren and five great-grandchildren. "The Edgertons are both Midwesterners planted in the middle of Cambridge," says one of his former students, Marty Klein. There they continue to lead the kind of hospitable existence they always knew, merely transposed to the small-town environment of the academic community. "Esther says she never cuts the meat till Harold comes home," says his sister, Mary Ellen, "because she never knows

how many people she will have to serve."

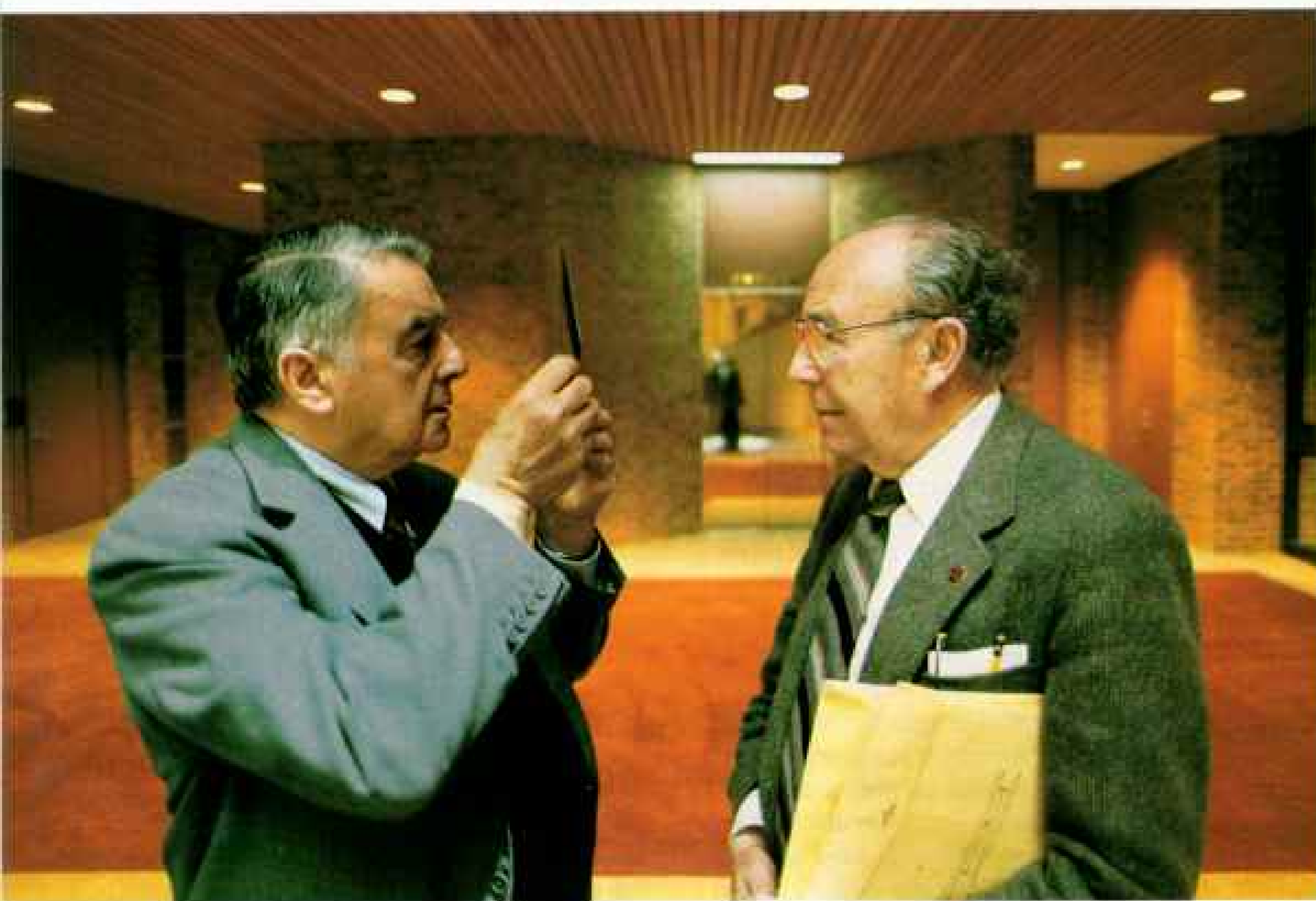
The down-home style masks a good deal of complexity. Edgerton's reluctance to speak of himself may well be modesty, but his scientific precision has impelled him to collect volumes of press clippings. Doc's humor punctures pretension and puts visitors and colleagues at ease, but it also serves a will very determined to get its own way. "He won't take no for an answer," says Senior Assistant Editor Mary Smith at NATIONAL GEOGRAPHIC. "I'd hear him on the phone to government people, and he just wouldn't let them get out of his grasp." As his assistant, Jean Mooney, puts it, "He has this uncanny ability to talk people into seeing things. I swear, if he'd never developed the strobe, he would've been a salesman."

Edgerton's Scottish-Midwestern thrift



*Pop go the flashguns when Edgerton emerges into "Strobe Alley," the hall outside his lab, to chat with a group of visiting tourists (right). Mary capture the moment with instant pictures, thanks to photographic pioneer Edwin Land (below), founder of the Polaroid Corporation, here peering at Doc through polarizing filters.*

*Strobe Alley—an informal corridor-museum—boasts an eerily lifelike hologram of Edgerton, as well as exhibits of his wide-ranging scientific expeditions. After meeting Capt. Jacques-Yves Cousteau in 1953, Edgerton acquired an enthusiasm for underwater exploration. Generous with his expertise, he has joined in the search to investigate such mysteries as Scotland's Loch Ness monster and the ancient Greek town of Helice, submerged during an earthquake.*





BOOTH BY BRUCE DALE

combines oddly with his well-known generosity. "Doc is a frugal man," says Gus Kayafas, who was once Edgerton's teaching assistant. "He remembers how exhausted he was working 12-hour shifts for 65 cents an hour, and it astounds him when some organization asks him for half a million dollars. Yet he's given ideas and patents away, and the new electrical engineering building on campus was partly his gift."

And the brilliant scientific intuition tends to flash past the more mundane details: "Doc is a haywire kind of guy," says Bernard O'Keefe, at one time the chairman of EG&G. "He puts things together, but when you get ready to make the product, you have to start all over again."

**T**HE FOUNDING of EG&G is revealing. Trying to sell the strobe as a commercial product, Edgerton approached General Electric. "I told them they should market the gadget," he remembers. "They did a market study and found they could sell maybe 50 of them, and weren't interested." Instead he joined forces with a former

student, Kenneth Germeshausen, to develop it independently.

"We didn't succeed at first," Germeshausen says. "So we started a consulting business using strobe photography to solve industrial problems—everything from better tennis rackets to sewing machines. We had no formal agreement. We never worried about who was getting the credit, and if we made money, we just shared it. When we had enough business, we brought in Herbert Grier." Today the company originally named Edgerton, Germeshausen, and Grier has 23,000 employees in 47 divisions around the world.

"Doc is exceptionally inventive, yes, and he has an art of simplifying everything," says Jacques Cousteau. "But for me, the most important thing is his ability to communicate with anybody immediately. Twenty seconds after he's met somebody, there's no barrier between them. That's fantastic." This gift, joined with curiosity, has made Edgerton a remarkable educator, as generations of students attest.

"He's incredible," says Marty Klein, who went on to manufacture commercial side-scan sonar equipment—one of the devices that was used to locate the *Titanic*. "He has an uncanny way of encouraging people by first giving them the tools, then giving them the impression that the job can be done. In school he didn't do experiments—he called them experiences. I would never have done what I've done without Doc's encouragement."

"He's infectious in the way he encourages people to go out and *do* things, to *try* things," says MIT graduate and friend Robert Rines, now a law-school president. "He gets across a lot of conviction that people can do things they think they can't. He challenges them to dream."

The openness has taken more than academic forms. Gus Kayafas remembers Doc Edgerton cosigning his application for a car loan. He also discovered years later that Edgerton had been paying his salary out of his own pocket. "So I went to him and said I wanted to thank him. He said, 'Just thank me.'" Kayafas repaid him several times over by producing for the fine-arts market portfolios of Edgerton's photographs, which sell for as much as \$5,000.

"Very often Edgerton would get students to write articles with him," says Marty Klein. "They might not get them published on their own, but with his name on them they'd have the thrill of seeing them in print. And when he made sonar records of the seafloor topography, he'd put everyone's name on the printout. The captain, the crew, everybody."

"At MIT there was a lot of talking," Kayafas muses. "But for him the experience wasn't so much giving the information, it was a process—learning to ask questions, not to get the answers that you expect, but the ones that present themselves. Doc said if a professor fails more than one or two students, it's the teacher who's failing. He'd say that teaching isn't about proving people wrong, it's about getting them interested and excited. He was a great lesson for me that I could love someone deeply from another generation."

**D**ESPITE Doc Edgerton's verve, the passing years have taken their toll. There is no visible evidence of the serious stroke he suffered seven years ago, though he experiences double vision in his one good eye, the right one, and a resulting sense of vertigo. He no longer drives, and now and then his associates see uncharacteristic bursts of frustration directed at his undependable body. These days he only occasionally comes down the hall whistling Brahms or Beethoven.

But the characteristic energy remains, even when he is simply leafing through his scrapbooks one afternoon. "I like this picture because it didn't do what I wanted it to," he says. "I came here to learn, and I'm still learning." Of a disappointing underwater project, he says, "We found nothing, but that's easy to do. The ocean's a terrible big place. Even when you know where things are, you can't find them."

About scientific discovery: "You have to have an awful lot of help. Sometimes I feel guilty. People think I'm in here inventing all the time. What I ought to do is get busy on

high-speed photography. There's still a lot of things to be done. Don't know what they are. I'll leave it for the next generation. I don't want to be selfish, do I?"

About field research: "If I knew what we'd find, I wouldn't bother to find it. People think research is like cutting wood and stacking it up. I was working with Cap'n Cousteau. We worked and worked, didn't get anywhere. That's how you know you're doing research."

**W**HEN EDGERTON devised special cameras to search for the Loch Ness monster, he was not impressed by the results: "I told all those researchers that no self-respecting monster would go near all that machinery they put down. I'm a scientist. I take evidence. I'm not going to make a conclusion from a foggy thing in the loch. You can't tell if it's a boy or a girl."

Does he like students? "I like making them work. When they decide to work, it's amazing what they can do. They weren't just pressing their pants in my class. I always gave 'em something to do. Only mystery I could never solve was whether the boy who wore only a blanket to class had any underwear on."

Like his students, Edgerton's magic lamp continues to leave the lab to serve some practical purpose. It has become the standard flash on every new camera, and it blinks its luciferous warning from countless skyscrapers and airports. It has become a virtual member of the family. "There are four strobe lights in Aurora on the courthouse tower," says Mary Ellen Pogue. "My mother said at one time that she bemoaned my father being in the cemetery all by himself. I said, 'Well, mother, it's not lonely, because Harold's strobe light is constantly watching over his grave.'"

A research assistant looks into the room. "Doc, have we got any more playing cards?"

"Nope. They're all shot up."

He claps his hands. "Let's get out of here. Do something useful for a change." □

*Crowning glory of his portfolio, this photograph of a milk drop landing on a red cookie tin was taken by Edgerton in 1957 and is in the collection of New York's Museum of Modern Art. Ever the perfectionist, Edgerton is quick to point out room for improvement: Not every peak on the coronet is identical.*





HAROLD E. EDGESTON



NORTH CAROLINA'S OUTER BANKS

**Awash in**



By CHARLES E. COBB, JR.  
NATIONAL GEOGRAPHIC STAFF

Photographs by DAVID ALAN HARVEY

# Change

*Afternoon angler casts from a Nags Head pier on a summer day on the Outer Banks, a slender, sandy world endlessly shifted and reshaped by ocean, storm, and man.*



*A day on the sea winds down at the Albatross Fleet charter office on Hatteras Island. As a customer tends a catch of dolphin fish, Capt. Bill Foster sits on the stoop for a chat with Owen Hawkins, who once battled a 500-pound blue marlin*





to the rail of an Albatross boat, only to set it free. In 1937 Foster and his brother Ernal pioneered deep-sea charters off Cape Hatteras, where a "mixing bowl" of northern and tropical currents teems with migrating species from both regions.

**I**N FEBRUARY'S COLD, when the wind is razor-edged and blowing hard from the northeast, the sea along North Carolina's Outer Banks demands obedience to its raw power. Surly of temper, it may lash out harshly, jabbing the shoreline, sometimes smashing it with a roundhouse blow. If you venture onto the beach during one of these fits of temper, you will see barrier dunes change shape before your eyes as slices of sand are carved off and slide into the ocean.

Gulls and terns feint with the pounding surf, expertly timing their swoops and dips. Small animals scurry among the wax myrtle, sea oats, and other grasses; they concentrate on what is of paramount importance along these shores, survival.

The deluge of summer visitors—some 1.5 million each year—is still months away. Their place on this shore is now guarded by the boarded-up beach cottages strung along the dune line. Sullenly, persistently, the sea attempts to reach them. Man must build carefully here, for this sea is intolerant of weakness, relentless in attacking it.

I know. . . .

It was the previous September when Hurricane Gloria swept up the North Carolina coast, its winds at 74 miles an hour with gusts to 100. It slapped my Hatteras Island motel with enough force to cause walls and roof to shake. Air pressure dropped. My ears popped. What would have been bad at any hour was terrifying at midnight with power and water gone.

Outside in the howling night, wind-whipped trees bent toward earth. An ocean I had swum in just the day before now vengefully threatened to wash away the structures man had defiantly built along its shores.

Nervous, sleepless, huddled behind a barricade of mattresses and plyboarded windows, I awaited the worst, trying to imagine what to do if the roof flew off, or the foundation collapsed, or a telephone pole was hurled through a wall. Hurricanes transform the ordinary into the dangerous.

Yet hurricanes and storms are ordinary on North Carolina's Outer Banks. Thus the primary lesson I had been gradually learning while traveling on these islands was being driven home: When nature declares eminent domain, man merely hopes to survive. And to survive, a balance must be created and re-created. "You can live here," Superintendent Thomas Hartman of the National Park Service had told me shortly

*Silvery morning fog creeps through booming south Nags Head, where development stirs mixed feelings. "It's distressing," says a West Virginia woman who has summured here for 15 years. "The more construction, the more erosion."*



after I first arrived, "but you've got to accept the Outer Banks on *their* terms."

There was a sudden calm; the eye of the hurricane had reached us. I wondered if I had done a wise thing, staying with those few Outer Bankers who spurned the National Weather Service's advice to evacuate. The hurricane, the advisory had warned, could be a killer. Then the buffeting resumed as the eye of the storm passed.

After taking one life, Hurricane Gloria relented and swept northward, leaving wrecked buildings, piers, boats. As I watched the Outer Bankers begin repairs and cleanups, I thought about what had shaped these sturdy folk—and what lay ahead for them.

For they were in the midst of another storm, one that would not pass. That storm was change. The Outer Banks, long "North Carolina's best kept secret," were in the midst of development, with newcomers arriving, condominiums rising, roads jammed, the Bankers and a way of life bending like dune grass before a great wind.

**"S**OME CALL it progress. I call it rape," Nellie Myrtle Pridgen, a Nags Head native, snapped when I asked her what she thought of the development pressing in all around her along an asphalt strip she remembered as beach. Cinder blocks and planks barricade the front of her home. On them a hand-painted sign warns: "Keep out!" Might as well post a sign telling the ocean to keep out.

Nellie had shown me, inside her house, the memorabilia of an earlier time, of decades spent by the sea: shelves of shells, sand dollars, fulgurite—abstract glassy shapes formed when lightning strikes the beach and fuses its sand. And photographs from her youth, showing flat, unbroken beach from sea to sound.

We strolled the beach, passing the weathered old houses of an earlier, more graceful tourist era. Here, where the ocean's roar muffles the sounds on the roads that pass her home, we talked of storms and of hearing the sea. "To me," she says, "on stormy days when the tides change, it sounds like they're throwing out a load of lumber."

My ignorance of the sea is embarrassing; she is kindly about it: "To know what this

sea is doing, you must see it on every tide."

After our beach walk, Nellie Myrtle's eyes swept quickly up and down the road we had crossed, at the housing developments and the traffic. Her mind went back to the times she cherishes, when the island seemed almost to belong to her and a few others. "Well, it's gone; it's all gone now."

Tourism and vacationing began on the Outer Banks in the early part of the last century. When the editor of the *American Beacon* visited Nags Head in the summer of 1851, he wrote of "picturesque dwellings on the hills occupied by the intelligent and wealthy Carolinians, who . . . pass in refined social intercourse, surrounded by the health reviving breezes of old Ocean. . . ."

Today Nags Head and its sister towns—Kitty Hawk, Kill Devil Hills, and Southern Shores—remain the hub of tourism.

The Wright Memorial Bridge, stretching long and low across the junction of Currituck and Albemarle Sounds, is one of two points of access into Dare County and onto the Banks (map, pages 492-3). From here, after a short drive east, Highway 158—the "bypass" paralleling a narrow beach road—runs through these famed resort towns.

On any given summer day both roads are a nightmare of traffic as an average 60,000 visitors make their way to sea. At night the roads are lit by the neon glow of restaurants, hotels, and motels. All strain resources of water, sewage, electricity, and patience. Says Karen Shepherd Macmillan, a long-time summer resident: "Once you could ride your bicycle up to Duck village and never see a car. Now Duck is up for grabs. We used to laugh at overcrowded Virginia Beach. I think what drew people down here is a way of life that isn't any more."

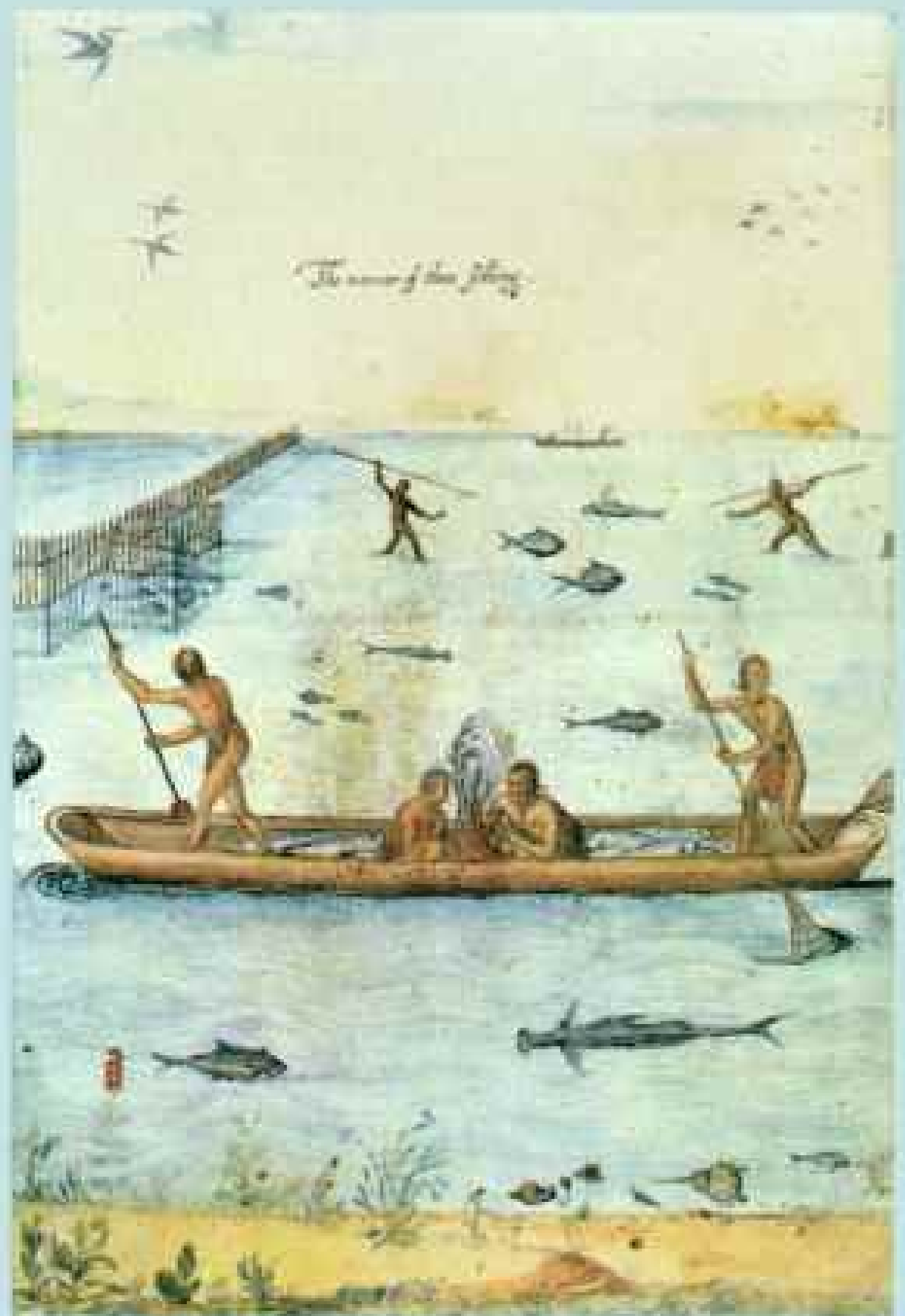
"Growth," says Nags Head Mayor Donald Bryan, "is at such a rate you can't by normal means keep up with needs." Eighteen thousand of the Outer Banks' 21,000 year-round residents live in Dare County, and a recent projection warns that uncontrolled development could swell population to more than 95,000 by the year 2000. Mayor Bryan estimates that Nags Head alone will spend 60 million dollars for services over 20 years.

"Consider our jail," said Bobby Owens, Chairman of Dare County Commissioners. "It's a nice old jail, and it was fine when



# Impressions of an early visitor

ENGLISH COLONIAL leader John White chronicled the fishing skills of Outer Banks natives in this drawing from the 1580s. In shallows between island and mainland, Indians use spears, dip nets, and a weir to harvest crabs, bluefish, hammerhead sharks, and other sea life. A canoe fire aids nighttime fishing. White's map of the Outer Banks (below) includes "Roanoac" Island, at center, where in 1585 colonists attempted to establish the New World's first English settlement. Compared with a 1986 Landsat photomosaic, his shorelines prove surprisingly accurate, considering White's crude instruments and the constantly changing land forms.



TRUSTEES OF THE BRITISH MUSEUM (ABOVE AND BELOW LEFT)



COBAT COMPANY/GENERAL ELECTRIC SPACE SYSTEMS

# Sea currents shape the Outer Banks

**A**T THE MERCY OF STORM AND SEA, the barrier islands constantly feel the influence of a complex interplay of moving water. In this depiction of winter conditions, cool water (blue arrows) flows southward along the continental shelf. Waves generated by frequent northeasters strike the land at angles (white arrows) and create the littoral drift that gradually carries sand southward. Warm waters of the northward-

flowing Gulf Stream (pink) hug the shelf slope. Clockwise-flowing eddies sometimes become isolated as the stream meanders toward and away from the shelf.

In summer the stream's warmth helps fuel hurricanes from the southeast (inset A) that batter the Outer Banks. With sea level rising over millennia, wind and wave action has pushed the islands landward (inset B), a process certain to continue (inset C).











everybody knew everybody. But it houses only 16 people. There are no facilities for juveniles or women. We need that now."

Resources are stretched to the limit in every area. "When I became a commissioner in 1970," Owens said, "we had a \$500,000 education budget. In 1985 it was eight million dollars for little Dare County."

To the crush of summer visitors has been added a growing number of winter visitors and people seeking retirement homes.

"Traditionally," says John Bone of the Outer Banks Chamber of Commerce, "our economy was characterized by a summer boom, a winter bust; now that's changing." There are year-round supermarkets, department stores, and boutiques. "I had lunch in a kosher deli the other day," Bone told me. "Twenty years ago people wouldn't have known what you were talking about."

**T**O GAIN new revenues and to slow growth, the county now levies taxes on land transfers and motel and hotel rooms. There is even a fee for a water tap. "Totally unheard of in Dare County," Commissioner Owens said.

The little Outer Banks towns have been discussing consolidation. Mayor Lowell Perry of Kill Devil Hills believes: "One municipality should be the ultimate result." Others favor administrative consolidations, such as central purchasing. Whatever the outcome, Mayor Bryan said, "The point is, we cannot continue trying to be rural when we are no longer rural."

You only have to look around to see that rural has turned to resort.

Construction is now Dare County's second largest employer, behind tourism. There's money to be made. One man had his beach home trucked to another site, so he could sell the beach site at substantial profit.

The question is not whether the Outer Banks will continue to develop, but how they will develop. Public officials and builders point fingers at each other concerning mistakes that have been made.

"There is terrific pressure from developers here," Mayor Elizabeth Smith of Kitty Hawk told me with a sigh.

For their part, many developers complain that local officials have been slow to coordinate planning. I spoke with Danny Daniels,

a developer based in Nags Head. "This is a beautiful place, and I want to keep it that way. There's not too much growth, there's not enough planning. When everybody is doing what's right in their eyes, we're bound to have problems."

Part of the difficulty lies in the nature of Outer Bankers, says historian and developer David Stick. "Because of the tradition of self-sufficiency and independence here, there is an innate distrust of anybody coming in and telling them how to do anything."

It was in 1947 that David Stick settled in the Outer Banks, hoping to make a living as a free-lance writer. His father, Frank Stick, was developing a four-mile stretch north of the Wright Bridge now known as Southern Shores. Needing money, David joined the venture, and upon his father's retirement became Southern Shores' prime developer until he sold his interest in 1976.

From the start he was concerned with minimizing damage to the fragile coast. That did not always sit well with his partners. "I insisted on a minimum size of 20,000 square feet for our lots. Almost everybody else had 5,000-square-foot lots. My partners didn't like it but went along, although



*A human tide carried by four-wheel-drive vehicles converges on ever shifting Cape Hatteras (facing page), popular for surf fishing. Erosion has narrowed the beach in front of threatened Cape Hatteras Light, at top, from 2,500 to barely 100 feet. After his van became stuck in soft sands on Ocracoke Island, a motorist learns a costly lesson about the unremitting tide (above).*

we didn't make the money we could have."

Developers have to assume responsibility for development, he told me. He rejected the idea that if local building codes are weak, developers can be excused for poor and risky properties. "In south Nags Head you don't have developers, you have land subdividers, land desecraters." He called them the "prime villains," adding, "The second villains are banks that loan them the money."

Villainous was not a word I heard most Outer Bankers apply to development. For all the longing in their hearts, in their heads they knew change was inevitable. And they welcomed its benefits. The good old days were not that good. "We were always able to live here," one old-timer told me, "but we never made any money until now."

**W**HEN FOLKS from Nags Head want to get away from it all, they head south—and so did I, across the bridge over Oregon Inlet to reach Hatteras Island. Here the visitor can find genuine solitude, can travel for miles hearing little more than the sound of geese, gulls, and the sea.

Hatteras villages are quiet and unobtrusive, hidden as they are "back of the beach," meaning along Pamlico Sound. They are little hamlets of wooden homes, many held by the same family for generations. People do not reveal themselves easily to outsiders, but they politely tolerate questions. "We just kinda washed ashore," one family told me.

Most of the island is national seashore, so the sprawling beachfront development of Nags Head is not possible here. But the villages, all unincorporated and without zoning laws, are squeezed for space and feeling the impact of change.

Just about everyone I talked with insisted I was now on the "true" Outer Banks. Said Gamaliel Ballance of Hatteras village: "The Outer Banks have always been from Oregon Inlet to Ocracoke." Said Dale Burrus: "At one time if you called folks from Nags Head 'Outer Bankers,' they got mad at you."

Hatteras Island has its own special link with the sea, its legacy of courage. Offshore are the churning waters known as the Graveyard of the Atlantic. Generations of Hatteras men served in the fabled U. S. Lifesaving Service, plucking survivors from



that graveyard. On a day of mist and wind I could imagine those times: horses pulling a surfboat down to the crashing sea, men in slickers manhandling the boat into the breakers, in their minds the old surfman's adage: "The rulebook says you have to go out; it don't say you have to come back."

I stopped by the small supermarket run by Dale and Allen Burrus. It was a general store when the family opened it in 1866. Dale said things are changing. Tourists now keep villagers busy with construction work, shops, and "party boats" for sportfishing. "Maybe," Allen ventures, "if we're not careful, the local person disappears and outsiders take over with their own ideas."

I encountered that nagging worry everywhere on Hatteras. "Sometimes I feel like the whole island is closing in on me," Buxton



*Rocking chair partners Etta Spencer and great-grandson Chad O'Neal visit on the porch of her home in Ocracoke village. "I get homesick for the way this town used to be," says Mrs. Spencer, who remembers Ocracoke before tourists began swelling its summertime population.*

*Crowded beaches in Kill Devil Hills convinced Russell and Camilla Hull of Elizabeth City, North Carolina, to sell their summer cottage, later moved (right) to make room for condominiums. "It is a time that shouldn't pass," says Mrs. Hull, recalling a less hectic era, "but it is no more."*





high-school shop teacher Elvin Hooper told me. "There are certain places I fish for channel bass; my secret places. Now when I go, people are there. The day of the true Banker is beginning to disappear."

However, Elvin recalls when his mother had to go all the way to Norfolk to shop. No one has to do that now. "You can buy almost anything you need here now. It makes it easy for me to stay home and work and prosper."

I talked with Elvin beside his school, where his students were building a cottage. They would learn construction and also tap the tourist trade. The cottage would be auctioned, the proceeds going to school needs.

I could understand the surge of vacationers here: Hatteras is a tourist's delight. I saw swimmers, surfers, sunbathers, hikers, lovers of solitude. Owen Hawkins, 74, from the Shenandoah Valley of Virginia, gave me an

insight into the lure of the island. He's been coming for 35 years to charter a fishing boat and head out to the Gulf Stream. "When the weather's right, I can catch more fish out of Hatteras in the least time than anywhere else," he said. "It's only 16 to 20 miles from Hatteras Inlet to the stream." He mused on memorable catches: dolphin fish, marlin—the last weighing more than 500 pounds.

Mr. Hawkins is retired now, slowed down by arthritis, walks with a cane, is unable to handle the big fish on a rod. And still he comes: "I tag along with my three sons to reminisce and give my boys the benefit of my fishing expertise. When they have a big one on the line, I coach 'em." It's the kind of thing, this Hatteras experience, that a man wants to pass on to his sons.

You might think that a village of only 650 people, on an island served only by ferry,





*Downtime for drivers gives an Asheville, North Carolina, couple a place in the sun as they wait for the ferry connecting Hatteras and Ocracoke Islands. Jim Coddington composes songs for his rock group, Clear Creek, as his wife, Leigh Ann, catches up on college studies. Founded by marine pilots in the early 18th century, Ocracoke village (below) was a hub for shipping and a haunt for Blackbeard and other pirates. Commercial fishing and tourism now sustain this village of 650 surrounding an inlet called Silver Lake.*





would escape the hand of change. But I found out otherwise at Ocracoke, the southernmost village on the Outer Banks. It is the only village on the island of the same name; most of the island is national seashore. Farther south stretch uninhabited islands accessible only by boat: Portsmouth with its abandoned village and Core Banks—both part of Cape Lookout National Seashore.

Ocracoke is a postcard vision: Frame

houses shaded by live oaks, yaupons, and red cedars; a small business center on a pretty harbor officially named Silver Lake but called by villagers "the Creek"; boats at rest.

The islanders still go down to the sea to fish—but mostly between tourist seasons, I was told. For all its smallness Ocracoke is also facing growing pains.

"The question we're dealing with," said Alton Ballance, an island native and then



chairman of Hyde County Commissioners, "is whether Ocracoke becomes a haven for people who want to make a quick buck, or whether it survives as a community."

As everywhere on the Outer Banks, the pace of everything is faster now. But islander Larry Williams notes: "Change is never as ugly as poverty and no jobs. Fishing never really supported us. Most men had to leave. When I came back, I had changed."

*Pelican on the wing punctuates a gray winter day at a Hatteras marina, where an idle trawler provides a perch for reflection. Only Hatteras and seven other small villages lie along Cape Hatteras National Seashore, the nation's first. Established in 1953, it contains 72 miles of marshes, dunes, and shallows stretching south from Nags Head to the tip of Ocracoke Island.*

The way Ocracokers deal with change tells a lot about their character. They've long held that a person has the right to do anything he wishes with his own property. Without zoning, businesses and residences grew side by side. When Ocracoke was just a fishing village, this was not a problem. It was the building of a three-story motel on Silver Lake that galvanized villagers to action. The "high rise," they complained, was an incongruous box of bricks.

Hyde County hired a consultant to come up with a plan. But, says Commissioner Ballance, "He didn't talk to anyone. He finally came up from Wilmington with a plan nobody understood or liked." It was rejected and, Ballance says, "I realized I should draw up a plan. I sat down with people and went through it one, two, three, saying 'Do you understand it? Is it too much to ask?'"

Zoning is still too hot a word here, so Ocracoke now has a "development ordinance." Under it a permit is required to develop any land or build any structure. Guidelines limit the height of any building to 35 feet and establish setbacks from property lines and public rights-of-way.

There is a lesson here for other areas of the Outer Banks where local resistance to regulation is strong, Alton thinks: "The whole thing here was trust, you know. This was someone from Ocracoke speaking to them."

**T**HE GOVERNMENT—now that's a phrase to get a Banker's dander up. I discovered this in the fishing village of Wanchese on Roanoke Island. I found too that not all the Outer Banks are riding the current of development. In a strict sense, Roanoke is not one of the Outer Banks; it is not a barrier island. But its history and culture are inseparable from the Outer Banks.

I followed a narrow country road that I'm sure no tourist would take on purpose and arrived at Wanchese. It presented little obvious charm: mostly houses, some with their own little canals for boats; piers and warehouses; piles of gear. Development was not the issue here; livelihoods were.

A few years back a program had been undertaken to change Wanchese into a major center for offshore commercial fishing. A "seafood park" with packinghouses was

begun. But things had gone wrong. The fishermen blame environmentalists.

"It's really a story of betrayal," Joey Daniels told me in his seafood-company office. Willie Etheridge—"Uncle Junior"—chimed in: "All the politicians are scared of 'em." These were angry men, their toughness formed by the hard dawn-till-dark work of wresting a living from the sea.

Men below were packing fish, but not much; outside, the harbor was nearly empty. Joey explained that most of the fleet was up north, working out of Hampton. He said they could pack twice as much here at Wanchese, but not until they had a permanently clear channel through Oregon Inlet.

Oregon Inlet separates Bodie Island from Pea Island, now the northern end of Hatteras. The inlet opened during a hurricane in 1846. Since then its southern shore has migrated nearly two miles, eroding the sites of lighthouses built in 1848 and 1859. And each year about 700,000 cubic yards of sand are trapped, creating massive shoals that threaten the increasingly larger fishing boats that use it as a door to the Atlantic.

The U. S. Army Corps of Engineers proposes two jetties—basically huge rock walls—more than a half-mile out into the sea to stabilize the inlet (page 509). This is what the fishermen want. The Department of the Interior says "No!" It would destroy the shore's equilibrium and hasten erosion.

Others oppose the jetty. I talked with George Deems, president of the North Carolina Beach Buggy Association, representing 3,200 recreational fishermen. Of commercial fishermen, Deems said: "Most think they own every damn fish in the ocean. These lands were given for recreational purposes." He insisted he was not against commercial fishing, but believes that dredging strikes a balance between commercial and recreational needs. "It will get them a channel."

The Wanchese fishermen reply that dredging alone barely keeps this perilous inlet open. According to the Corps of Engineers, from 1960 to 1983 dredging operations have maintained a 14-foot channel only 25 percent of the time.

With jetty construction frozen by debate, Wanchese's seafood park seemed a depressing symbol of shattered hopes. Still mostly undeveloped, it was supposed to create 500



*"Still country and stubborn," says Betty Etheridge (right), describing her hometown of Wanchese, a small fishing village at the southern end of Roanoke Island. With her constant companion, a pug named Ho-Ho, she waits for her husband, Willie Etheridge, Jr., to return from a day of shrimping (below). "I do it now mostly as a pastime," says Willie, who has spent his working life on the water. He also lobbies to protect the interests of commercial fishermen, advocating the construction of jetties to maintain access to the sea through shallow Oregon Inlet. Other family members have joined him in other enterprises, including wholesale and retail sales and a seafood restaurant.*







*Blizzard of sea foam drenches a visitor to south Nags Head during a January northeaster (left). At a nearby beach house, owner William Kurpe and his children keep watch (facing page) as the surf batters a sand fence erected to control erosion. Since the storm, Kurpe, a Pennsylvania businessman, has had the pilings buttressed with crossbeams. Kurpe and his wife, Virginia, ponder the perennial question faced by shoreline property owners: whether or not to move their house inland.*

*Winter winds sculpture the surface of Nags Head's Jockey Ridge (below), largest sand dune on the East Coast. When housing developers began bulldozing the 130-foot-tall dune in 1973, a public outcry led to its preservation as a state park. Today, it is a favorite spot for hikers and hang gliders.*



primary jobs and 125 spin-off jobs. "What we have," says its administrator, Nina Johnson, "is 55 jobs. I'm disgusted."

How is an outsider to know which argument is more valid—the need for incomes at Wanchese, or the wisdom of allowing nature to work her way?

**I** DROVE north now, past Nags Head and Duck and beyond. It had been a year since I'd been this way, and I was struck by how in that time so much open ground had sprouted houses and stores, coveys of vacationers. But at Corolla the highway and the houses end.

I took to the beach and drove on. I gained a stronger sense of the Outer Banks as they once were. Powdery sand drifts across a flatter, less developed landscape. To the west, along Currituck Sound, marsh, tidal creeks, and ponds shelter migratory birds. And then I reached Carova Beach, just south of the Virginia line.

It was an almost invisible collection of trailers and small homes, seemingly bound together only by a desire for solitude. The permanent population, I knew, was some 30 families, but it appeared a ghost town. I saw parked cars and now and then the movement of a curtain, but not a single person.

So I drove back to Corolla. There was a post office there and presumably information. Postmaster Norris Austin chuckled when I described my dilemma. "Probably thought you were from the government," he said. He offered to go back up to Carova Beach with me, and there he introduced me to blunt-spoken Ernie Bowden, stockman and contractor. He had the outdoorsman's rugged face and toughened hands.

There were once big plans afoot for this part of the Outer Banks. During the late 1960s hard-driving Virginia Beach developers began to sell prime oceanfront property all along this coast. And indeed, by the 1970s most of the coast had been sold—some 2,300 lots.

But there is no road—not south to Corolla, not north into Virginia. Federal and state preserves blocked construction. Local folks were ambivalent about this.

But they were united on one issue. Traditionally they have traveled the beach to Virginia for supplies. When the beach became



impassable, as at high tide, they drove a sandy track behind the dunes.

Traffic was restricted by the U. S. Fish and Wildlife Service, seeking to protect the Back Bay National Wildlife Refuge in Virginia. Two gates were installed, one at the Virginia-North Carolina border, requiring a key to unlock, the other at Back Bay's northern edge, requiring a magnetic card.





Long-time residents could pass through the gates, but not between midnight and 5 a. m.

So most of the lots around Carova Beach remain unimproved. And for the few residents without permits, keys, and cards, getting to Virginia means going the long way around—25 miles south to the Wright Bridge, then north another 50 miles.

They do not like it.

*Bagging his limit with one shot, Robert Ferrell of Moyock retrieves a swan from the shallows of Pamlico Sound, where Mayo Boddie waits in a curtain box surrounded by Canada geese decoys. Since a state ban was lifted in 1984, hunters may shoot one swan per season. A permit system limited last season's take to 6,000.*



Several years ago Ernie was arrested for crossing the beach after curfew and served 58 days in jail. "And for what?" he asks and answers, "just trying to get back home." His work makes his need for unrestricted access to supply centers in Virginia urgent: "The tide doesn't follow government regulations." But Back Bay refuge officials say the controls are vital to maintaining a sanctuary for the area's wild creatures.

Wild horses roam along Currituck Sound as well, Ernie told me. And sure enough, as I watched him round up cattle on his fenced range, a herd of wild horses led by a black stallion thundered out of the woods.

But the most unexpected sight was the buffalo. He is experimenting in crossbreeding them with cattle to get beefalo, a leaner meat. "Just something I'm trying."

His cattle and buffalo sometimes make their way to the beach to escape the flies

and mosquitoes that swarm in the evening. "U. S. Fish and Wildlife officers shot one of my buffalo," he told me with more sadness than bitterness in his voice. "I don't know why they had to do that."

Wildlife officials explained, however, that the animal was headed for a public area in the Back Bay refuge.

When the federal government opened the new Currituck refuge in 1985, Corova Beach residents feared that travel south behind the dunes would be forbidden. However, federal officials have promised to allow travel through the new refuge.

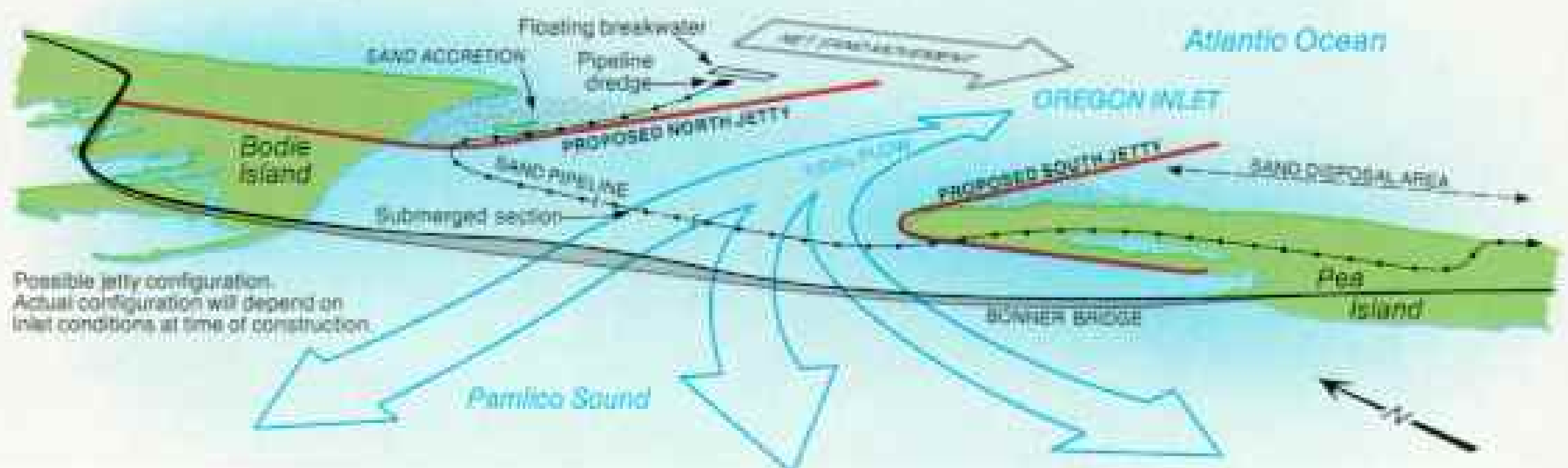
The fences are still in place "and that won't change," an official at the Back Bay Wildlife Refuge told me. "We can't have everybody from Virginia Beach driving down through here." Travel on the beach between the gates is still forbidden without a permit.

As with so many conflicts on the Outer



**Stork-legged go-cart called the CRAB** (coastal research amphibious buggy) creeps through the surf near the U. S. Army Corps of Engineers research pier at Duck (left). Operable in depths up to 30 feet, the CRAB measures sand buildup and erosion on the ocean floor. A laser beam shot from shore bounces off a prism on the vehicle platform, precisely gauging up-and-down movement.

Graceful shoals on the sound side of Oregon Inlet (above, foreground) illustrate the formation of sandbars, marked by surf on the seaward side. Keeping the inlet navigable now requires constant dredging. The Corps of Engineers proposes to build two jetties and a sand pipeline under the inlet (below). Favored by commercial fishermen but opposed by environmentalists, the plan is deadlocked.



Banks, I found it difficult to know how to feel. But the balance between differing human needs was only one of two questions that tugged at me as I traveled. The balance between man and nature was the other. I would find that no easier to answer.

A September morning brought a stiff northeast wind that blew at 30 miles an hour and kept small craft out of the sound. But by afternoon the wind gentled and the sound

smoothed. As evening approached, the setting sun's reflected light danced across the water like diamonds.

A half-mile off the north beach of Roanoke Island, I looked landward from the small wooden boat I shared with University of Virginia geologist Robert Dolan. Recent storms had chewed up the shore and spit out trees, leaving them broken and scattered.

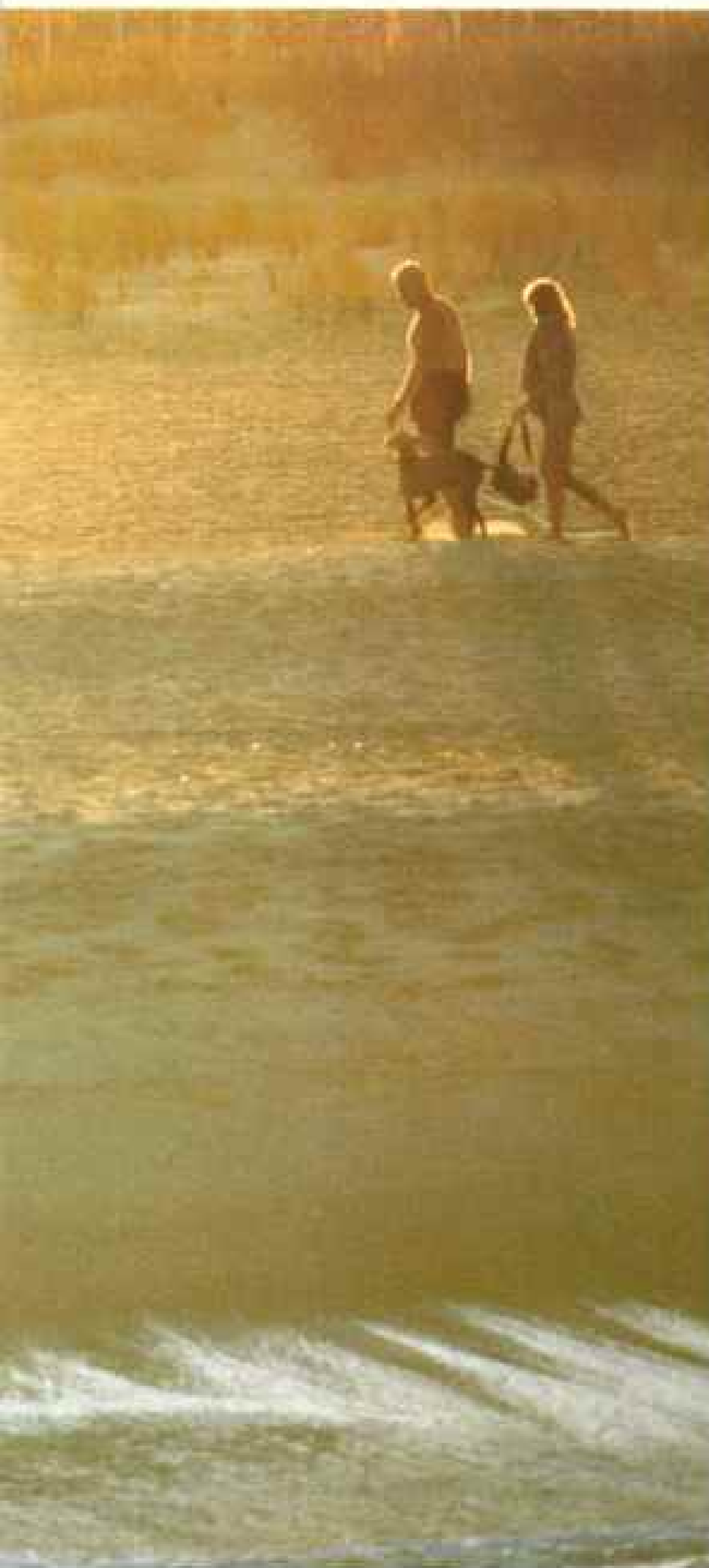
I had come in search of the "lost colony" of





Roanoke, part of Sir Walter Raleigh's effort to found English-speaking settlements in America. In 1587 a colonizing party landed—and three years later vanished, never to be found. Among the 116 missing was Virginia Dare, the first child born of English parents in America. The name of an Indian village, "Croatoan," carved on a tree trunk, offered one clue to their whereabouts.

"What's left would rest somewhere



beneath this water," Professor Dolan said.

Behind the pines and live oaks that fringe the beach, there is partial reconstruction of the crude earthworks fort built by the first settlers. "They would have built on the highest, most stable part of the island, no doubt hunting and farming between the fort and the shore," Dolan said. "But their farms have been swept away by erosion and storm action; a quarter to a half-mile in 400 years. It's still happening." He first saw the beach 28 years ago, Dolan said, and in places it was 300 feet wider than it is today.

**E**ROSION and storms pose a problem for modern settlers on these islands. Last April howling winds of a two-day northeaster sent waves six to ten feet high crashing into the Banks. In south Nags Head erosion caused three cottages to slide into the ocean. Another 26 have been condemned because they have lost so much land that there is no place for septic tanks.

I drove down the beach in June with Nags Head Public Works Director Skip Lange. A dishwasher lay forlornly in front of one cleared lot. Collapsed wooden walkways seemed to kneel in obeisance to sand and sea. The familiar dunes were washed away.

Sandbags surrounded many homes. "If we get another bad storm, a lot of the houses will go," Skip said as we paused at a subdivision where, even on this bright day, the ocean lapped at the steps of some cottages.

Jack Wallace has lost two sets of steps and fifty feet of beach in ten years. "I'd like to sell the house," he told me. I find it a little ironic that he is a real estate appraiser. "I'll sell my house to you for \$165,000. If there wasn't erosion, I'd get a quarter million for it."

According to officials, hundreds of North Carolina oceanfront properties are threatened by erosion. Bulkheads and concrete seawalls are prohibited by law. While these

*Long shadows and golden light foretell the end of a summer day for swimmers and surfers enjoying Cape Hatteras National Seashore near the village of Rodanthe. So changeable are the shoals off Hatteras Island, says a local resident, "you can't tell where the good surfing is going to be year to year."*

structures may offer temporary protection, they may also concentrate wave force and hasten erosion. Owners of homes on eroding beaches are encouraged to move back from the shoreline. New homes must be set back thirty times the annual erosion rate.

Many homeowners do not have lots big enough to set their houses back. To be safer, they would have to move to another site, and federal flood insurance doesn't yet pay for that. So they rebuild on eroding property. Says Jack Wallace: "If I had known ten years ago what I know now, I wouldn't have built here. The ocean is like a hippopotamus; it sits where it damn well pleases."

Even the Outer Banks' best known landmark, the old Cape Hatteras Light with its distinctive black and white spirals, almost collapsed into the sea a few years back—workmen tore up a parking lot and stacked the slabs of asphalt in front of the lighthouse to save it. It remains threatened.

When it was completed in 1870, half a mile of beach separated it from the sea. Now the beach is only 100 feet. The government has four choices: Let it fall into the sea; build an artificial beach around it; surround it with a seawall so that if the beach goes, the lighthouse becomes an island; put it on rails and move it inland. Cost estimates range from three million to six million dollars.

Compounding the erosion is a long-term rise in sea level. "And it's futile to fight it," geologist Dolan told me. There has been a one-foot rise this century—which means a 200-foot horizontal spread of the sea over beaches. Storms and erosion will increasingly threaten seaside communities.

Geologists have been limited in their ability to predict what will happen and when. Professor Dolan is testing a computer program aimed at analyzing erosion rates. He and his colleagues now believe they can plot

*Fugitive visitor from a bygone age, the remains of an unidentified 19th-century sailing ship emerged in 1985 on the beach north of Rodanthe, only to vanish three weeks later. Run aground in fog or storm, hundreds of ships have foundered in waters off the Outer Banks, giving rise to the epithet Graveyard of the Atlantic, a silent reminder to those who would underestimate this volatile place.*

patterns within what they are sure is a single barrier-island system, "because they are organized enough to be predictable."

University of Maryland geomorphologist Stephen Leatherman added a gloomier note: "Over the next century we predict beaches will erode from two to five times faster than in the past hundred years." Warmer temperatures, increased carbon dioxide in the atmosphere (which holds in heat), and melting of middle-latitude glaciers will all contribute to the rising sea level. "It's going to be increasingly perilous on the Outer Banks and other shorelines," he said.

**W**INTER CLOAKS the Outer Banks in different colors. The green ground cover of summer becomes brown. The sky is often gray, the days quiet. More than at any time, it was in winter that I considered nature's intricate network here, and man's place in it. I crossed the Oregon Inlet bridge, looked down on shoals that form the flood-tide delta, and marshes spreading into



Pamlico Sound. Now and then a car passed, but mostly there was stillness broken only by the calling of snow geese on their way to feed in Pea Island National Wildlife Refuge.

The refuge is a bird-watcher's paradise: herons, egrets, swans, ducks, 312 species in all. Perhaps there's a lesson here.

To the 750,000 visitors who come here each summer, the refuge must seem a perfect example of nature's handiwork untouched by man—but the truth is different. "This is almost totally a man-made system," Bonnie Strawser of the Fish and Wildlife Service told me. Half a century ago, the land here was treeless, sandy, flat. The ocean washed across it.

To protect the land, the government built sand dunes and sprigged them with grass. It dug ponds and controlled their water levels. In time the refuge's ecology began to change: Trees and grass grew. But in the 1970s the government changed its mind: It concluded that the man-made dunes inhibited the natural reshaping forces of wind and wave. The government no longer

replants the dunes; nature will have her way.

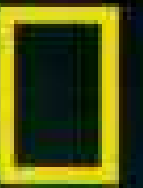
When I asked Thomas Hartman about the possibility that the sea would reclaim the refuge, he said there had been many assessments of the impact of losing the dunes—"but I can't tell you what would happen. Only God can really answer that."

So man had managed nature on Pea Island, improved it, but in the end had yielded certain powers back to nature. "You can live here, but you've got to accept the Outer Banks on their terms," Hartman had said. To survive, you must adapt.

The early settlers—Indian, shipwrecked sailor, villager—had adapted, had survived. But I wondered about all those people who today rush to be by the sea, or to profit from a house by the sea. These Outer Banks, after all, are only fragile sandbars, their shapes changing daily, the sea taking from one part, adding to another.

It is the sea that draws us to the Outer Banks; we are her guests. But as Hurricane Gloria taught me months before, these Banks are hers. □





# THE

# SMELL Survey

**L**AST AUTUMN 1.5 million of you dutifully scratched at six small samples of scent, sniffed them, and mailed in your reactions to the NATIONAL GEOGRAPHIC Smell Survey. In so doing, you took part in a landmark undertaking—the largest scientific sampling of its kind ever conducted.

How did you do? Most participants correctly identified most of the test odors—with a few telling exceptions. You will find the names of the scents and the scorecard on the next pages.

Among major findings: Women not only think they can smell more acutely than men, they generally can; reactions to odors vary widely around the world; and pregnant women, commonly thought to be smell-sensitive, may actually experience a diminished sense of smell.

Most surprising, the survey shows that nearly two persons in three have suffered a temporary loss of smell and that 1.2 percent cannot smell at all

Avery N. Gilbert and Charles J. Wysocki are biopsychologists with the Monell Chemical Senses Center in Philadelphia, the nation's largest research establishment devoted to the sense of smell and its impact on the quality of human life. Monell and NATIONAL GEOGRAPHIC cooperated in preparing and conducting the Smell Survey.

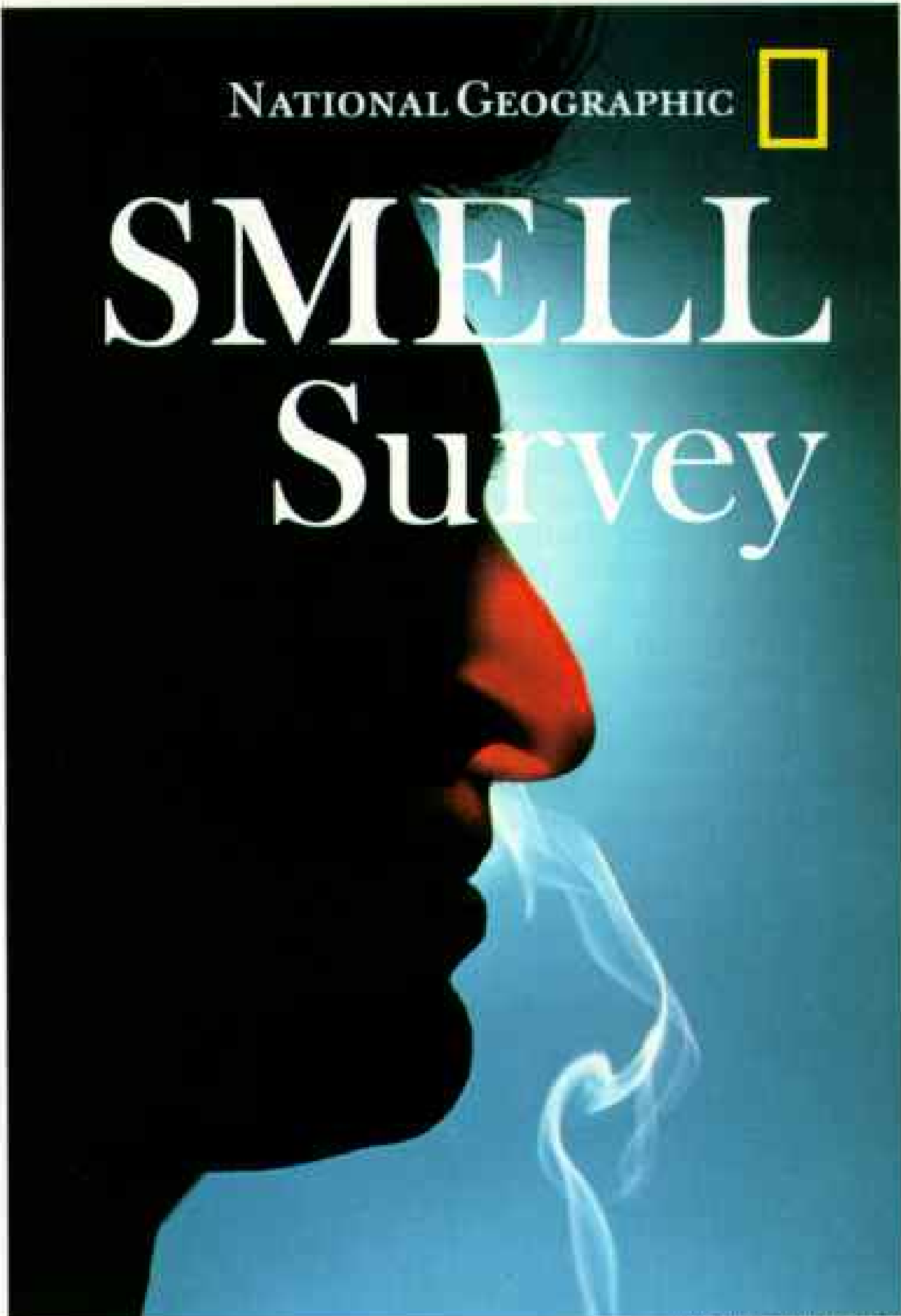
—new information of immense value to olfactory scientists.

Sight, hearing, and touch have been well explored, but the sense of smell has remained elusive, due in large measure to a lack of basic information. Now, as partners in research, NATIONAL GEOGRAPHIC readers have provided a trove of scientific data—enough to let us examine many long-held perceptions about smell and its relationship to sex, age, health, and other factors.

Also for the first time we have acquired hard data on

such personal characteristics as odor-evoked memories and the way we perceive our ability to smell. Their effects on responses to actual odors may help to target future research issues and to bring medical research to bear on disorders of smell.

The questionnaire reached members in the September 1986 issue of NATIONAL GEOGRAPHIC, accompanying an article titled "The Intimate Sense of Smell." Though only one person could fill out each questionnaire, many families participated by photocopying



PHOTOGRAPH BY LOUIE PSIMOTOS



*One and a half million members respond with important new data relating smell to age, health, pregnancy*

# RESULTS:

By AVERY N. GILBERT and CHARLES J. WYSOCKI

the survey form and sharing the odor samples. In the same way entire classrooms took part, from the fourth-grade class at Claywell Elementary School in Tampa, Florida, to a psychology class at Platt Junior College in St. Joseph, Missouri.

Some members gave the test to their infants and young children and observed their reactions. Others encouraged a variety of domestic pets to take part. A house cat in Atascadero, California, found one scent (Galaxolide—page 516) offensive enough to leave tooth marks on the survey form. A cairn terrier in Overland Park, Kansas, apparently agreed with the house cat in her own way.

Not everyone appreciated the test. A number of letters told of respondents with super-sensitive noses who could not stand to have the odors in their houses.

Much more work will be required to tally and completely analyze the unprecedented torrent of data from the 1.5 million returns. To bring you a tentative early look at our findings, we randomly selected a sample of 26,200 replies, all from the United States. We also collated results from 100,000 responses from abroad sufficiently for a single—and fascinating—international comparison (page 518).

While vastly more is to be

learned, we believe these general results will remain valid through further controlled studies in the laboratory. To foster additional research, we are tabulating the data on computer magnetic tapes and will make it available to researchers everywhere.

A survey of this magnitude could only be undertaken in the computer age; analyzing the returns by hand would be impossible. Nearly ten man-years will be spent merely keying the results into a computer preparatory to large-scale analysis.

To affix the scents to the scratch-and-sniff panels, the droplets of odorant were surrounded by long chains of molecules called polymers. These formed microscopic bubbles that burst when scratched, releasing the odor. Though the quantities of scent used were small, their value was high: The single ounce of androstenone donated for use in the test would have brought \$200,000 on the chemical market.

Our two-year collaboration with the National Geographic Society has been particularly gratifying. As scientists, we have a responsibility to inform the public. And as researchers, we hope to tap ever greater sources of information about human physiology and behavior. These two goals are beautifully intertwined in this project.

*“My sense of smell comes and goes. . . . Eating for me is something I do because I’m hungry.”*

*“ . . . my aunt’s house in desert Utah still smells exactly as it did forty years ago—of apples, banana-oil furniture polish, and old-fashioned floor wax.”*

*“My wife answered these questions. She is an expert. She can smell beer over the telephone.”*

*“I am three months pregnant and smells seem to trigger much of my nausea.”*

*“Nothing beats the smell of my garden except the fragrance of a new baby’s head.”*

*“Needless to say my ‘poor’ sense of smell stood me well during 25 years of dental practice.”*

*“Thank you for giving me the opportunity to help science in a minor way.”*

# Six odors challenged participants

Graphics by  
**ALLEN CARROLL**  
NATIONAL GEOGRAPHIC ART DIVISION

Painted by  
**MARK SEIDLER**

**T**HOSE WHO TOOK PART in the Smell Survey faced two major challenges—the first, to detect the odors described below; the second, to identify them correctly.

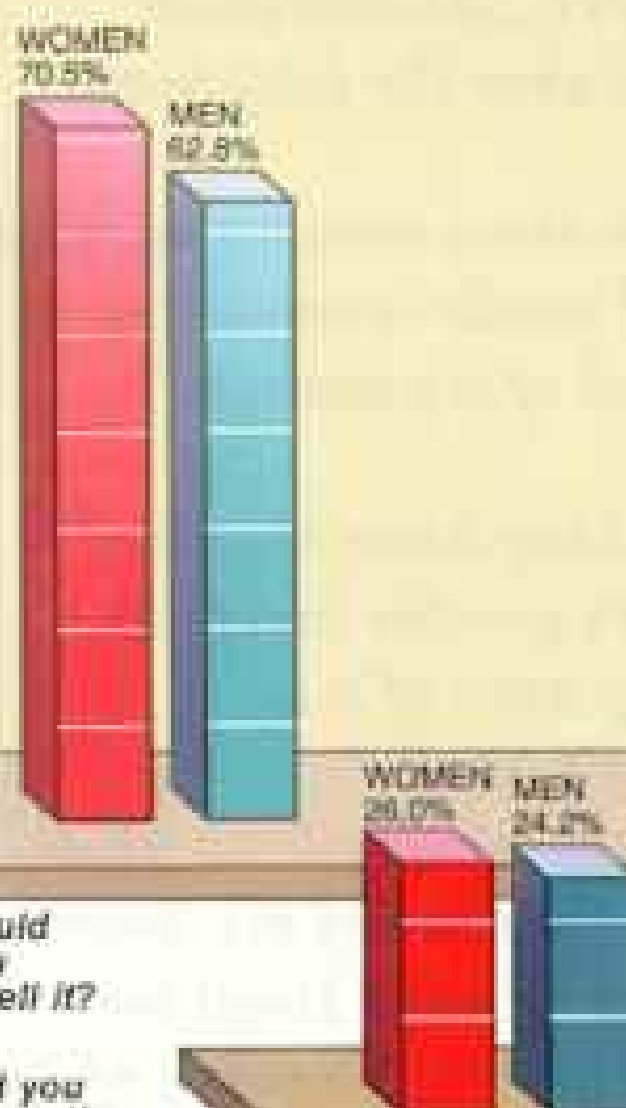
Fully half the participants could smell all six samples. At the other extreme, the proportion of people unable to smell three or more samples was relatively small (around one percent).

The results demonstrated widespread “odor blindness” in the U. S. to two samples. Androstenone and Galaxolide could not be detected by 35 percent and 29 percent of participants respectively. In contrast, less than 2 percent of the population has some form of color blindness.

The survey also showed that odor blindness—known as specific anosmia—to androstenone and Galaxolide are

## 1. Androstenone (sweat)

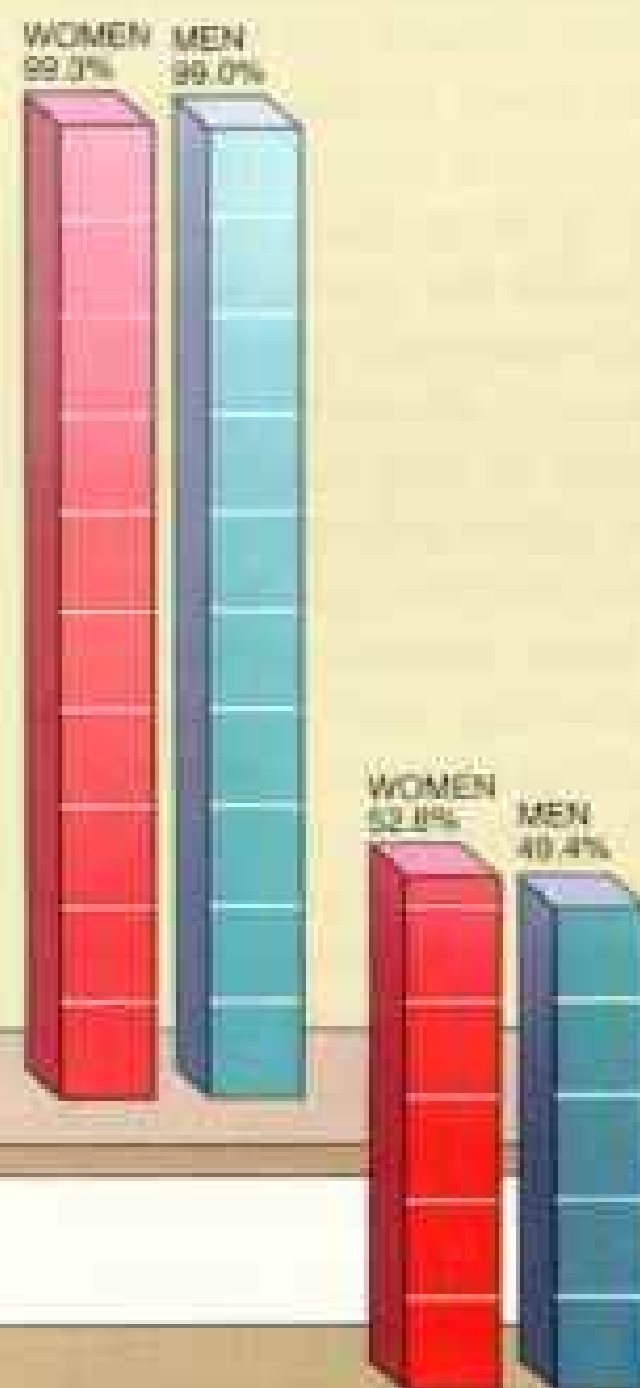
Occurring in some plants and animals, the compound androstenone is also produced by bacteria found in human armpits and appears in our sweat. Men produce greater amounts than women. People frequently display an anosmia, or odor blindness, for androstenone, making it of interest to olfactory scientists. More than a third of the U. S. participants failed to detect it—a trait that is probably inherited.



Androstenone posed greater problems of identification than any other scent. More women than men were sensitive to it but were almost as unsuccessful at identifying it. Of those respondents who detected an odor, most found it musky/urine, many others floral.

## 2. Isoamyl acetate (banana)

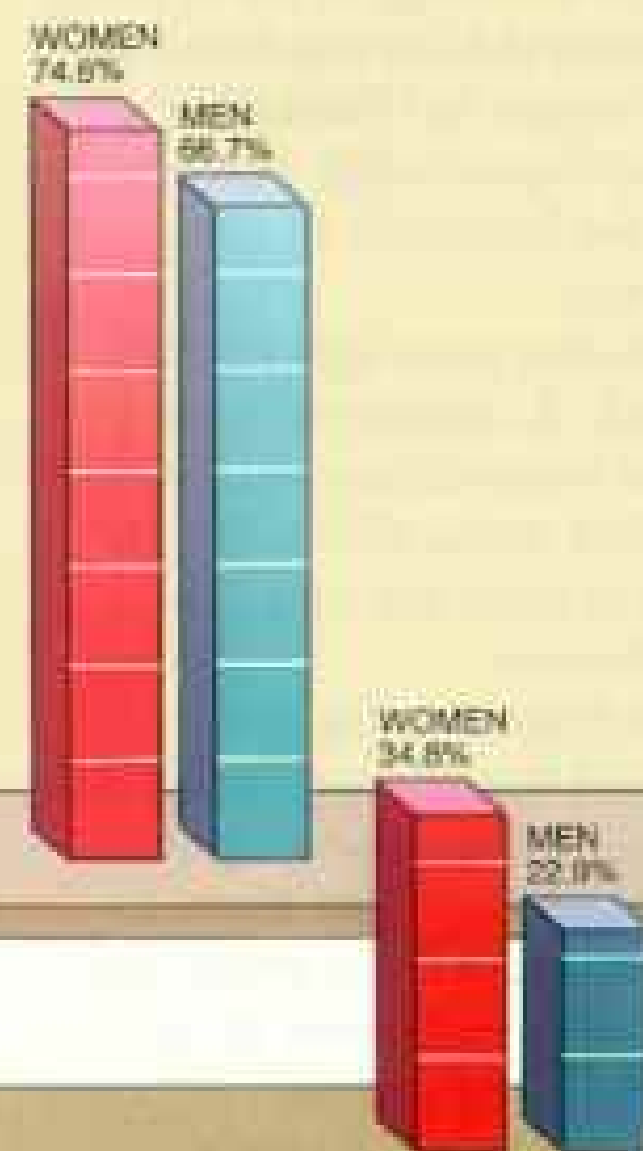
This familiar scent is known to most noses as the primary odor note in bananas and pears. It was chosen to represent the category of food-related odors and also because it is often a standard stimulus in scientific research on smell.



Among the most readily detected samples, isoamyl acetate was almost as easily discerned by men as by women. Identification proved much more difficult.

## 3. Galaxolide (musk)

Galaxolide was created for perfumers as a synthetic substitute for the “dark,” rich odor of musk, formerly collected from the Asian musk deer. While it or similar compounds are fundamental odor notes in fine perfumes, few people have had the opportunity to smell it on its own. As with androstenone, many people show a specific anosmia to this compound.



Galaxolide rivaled androstenone for difficulty of both detection and recognition. Frequently respondents who failed to detect one of the scents also failed with the other.

The difficulty of males in identifying this perfume base created the widest sex-related gap in the tests of scent recognition.

related. For the 13 percent of readers unable to smell any two odors, these two scents were paired with overwhelming frequency (92 percent). This result is new; in connecting these two specific anosmias, we may discover more about each. One clue: Both compounds seemed "musky" to many people.

To measure odor identification, 12 descriptions were listed for each scent. These

included one word that was considered an appropriate description, based on experiments in the laboratory. In the survey returns the description most commonly selected by participants was, in all cases, the "correct" choice.

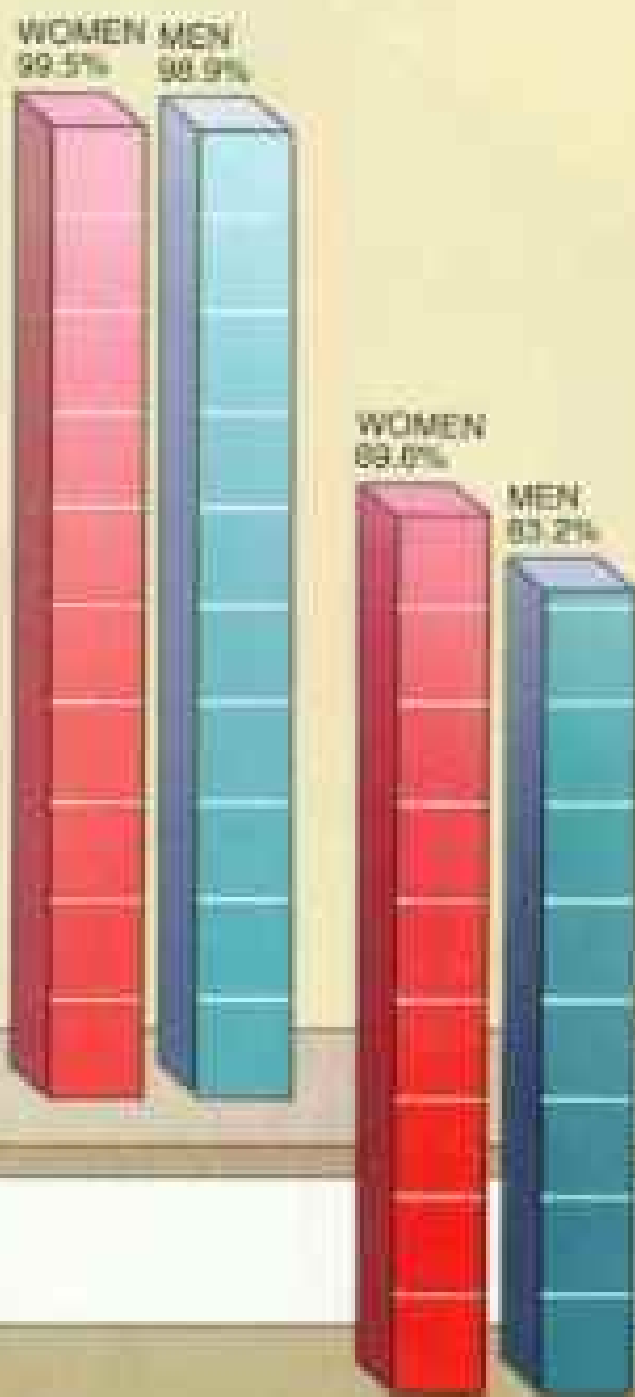
Thus androstenone was urine/musky, banana was fruity, Galaxolide was musky, clove oil was spicy, gas odor was foul, and rose was floral.

As we will see, many factors

can contribute to decreased smell perception. Age takes its toll, as in some cases do conditions such as pregnancy and tobacco smoking. Diminished perception can also result from what scientists call long-term adaptation, a process that takes place over the course of protracted exposure to an odor. A good example is the tannery worker who, after months on the job, is no longer aware of the foul smell.

## 4. Eugenol (cloves)

The principal component of clove-bud oil, eugenol also occurs in cinnamon-leaf oil and has a long history of use as a spice. It was included as a representative of the spicy, pungent class of smells and as a smell that would be familiar.

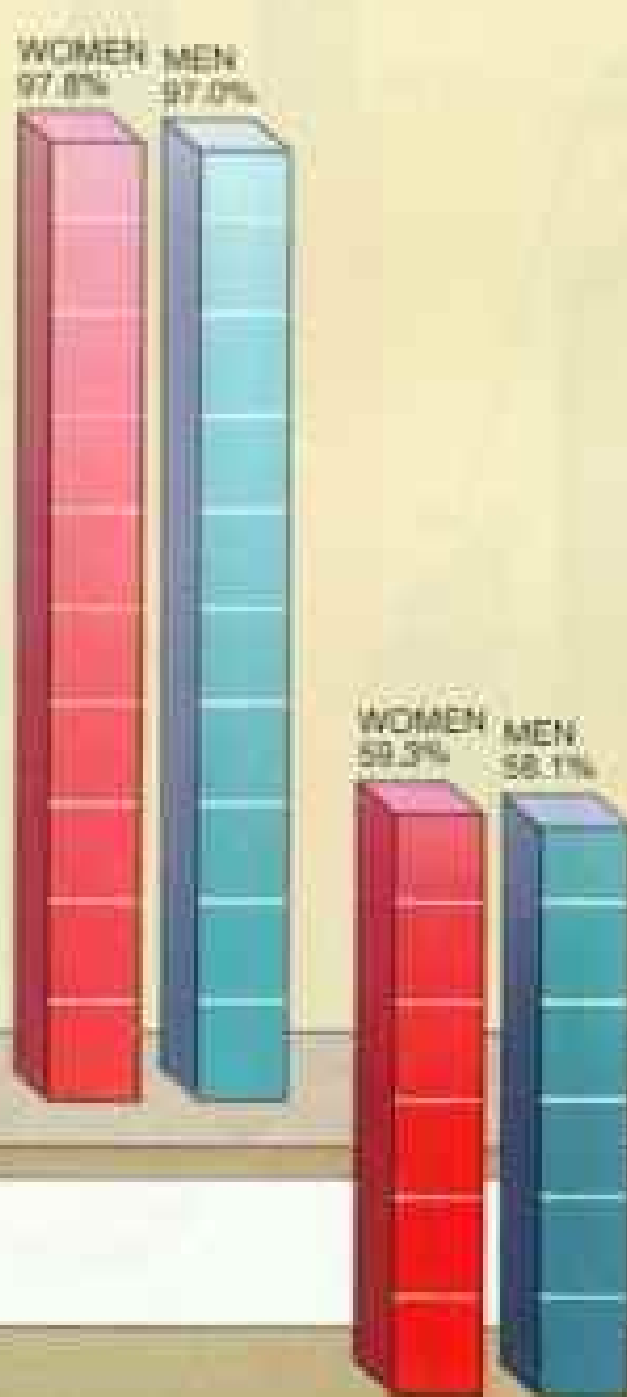


Like scents 2, 5, and 6, eugenol was selected partly because of its easy detectability, and thus its high yield of identification responses.

Familiar to cultures around the world, this "warm," aromatic scent scored highest among both sexes in identification.

## 5. Mercaptans (gas)

This mixture of sulfur-containing compounds includes the ingredients used to give natural gas its obnoxious warning smell. It was included to provide an odor generally regarded as unpleasant.

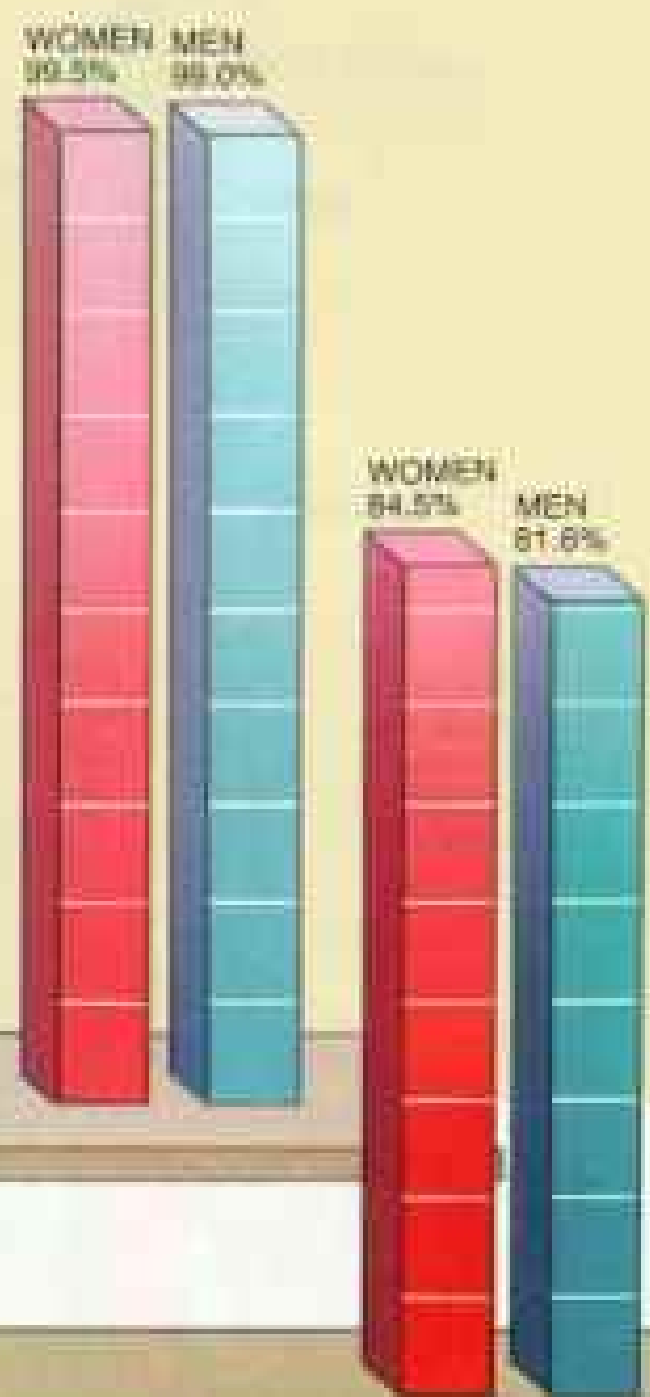


This was the only test odor designed to be both readily detectable and almost universally regarded as foul smelling.

Although identification ranked high, the mercaptans proved to be less unpleasant than expected to older age groups, revealing a potential source of danger (pages 522-3).

## 6. Rose

Rose is a fragrance prized through many ages and cultures. The odor in the sample was typical of many varieties but specific to no single strain. Rose was chosen to represent florals, a class of sweet, pleasant odors.



This traditional favorite for perfumes proved its pedigree by achieving nearly unanimous detection among women and scoring almost as well among men.

Perhaps the reason for this high detectability is that the scent is composed of many individual ingredients: If your nose missed one, it recognized another.

## Smell ability differs around the world . . .

ONE OF THE MOST surprising discoveries of the survey was the varying worldwide reaction to the first scent, androstenone.

Prior to examining the international returns, we had analyzed the responses to androstenone in four major cities across the United States: New York, Chicago, Denver, and Los Angeles. For each the percentage that could not smell the compound was almost identical. Wouldn't this

genetic trait prove consistent around the globe?

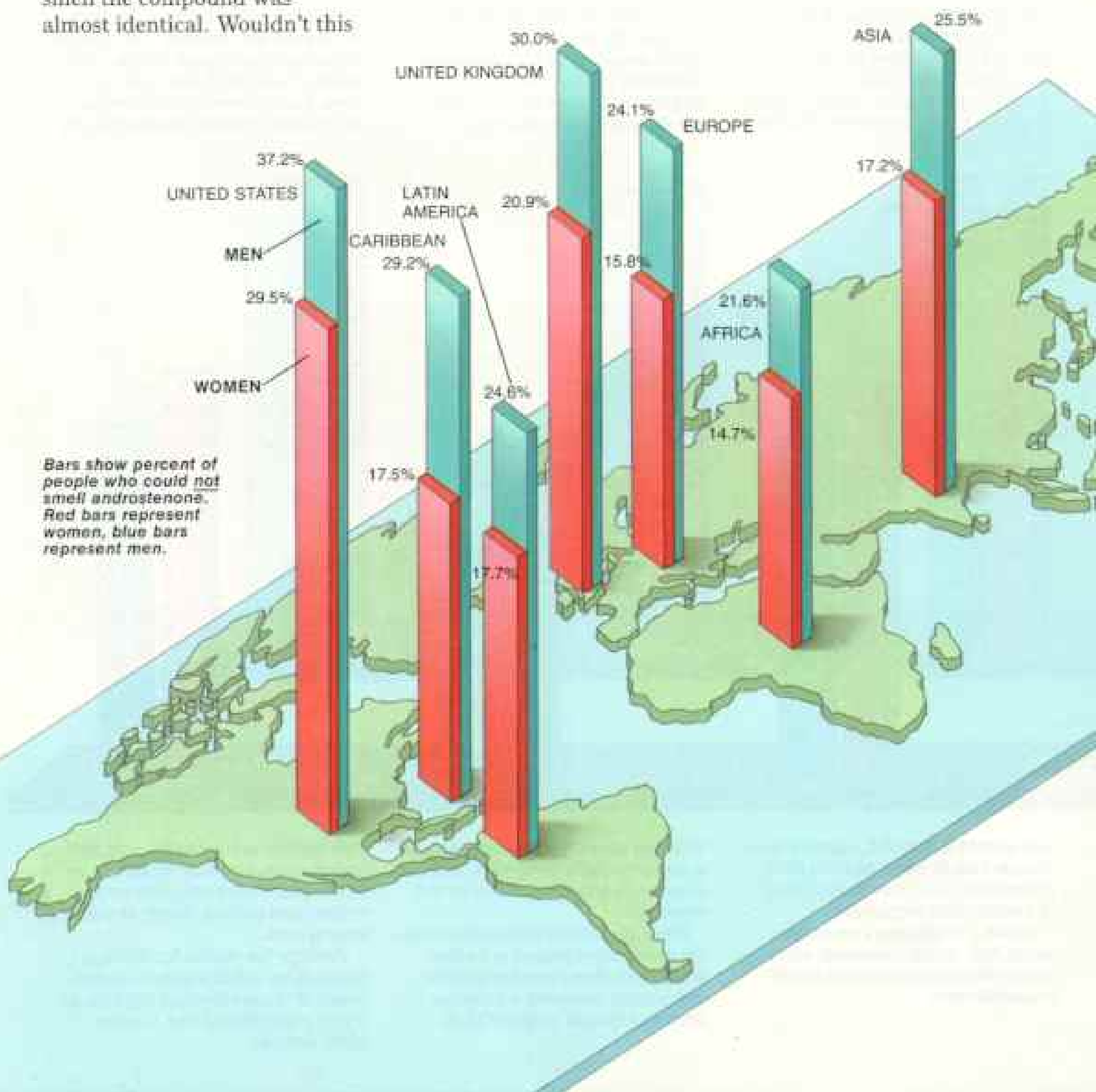
To the contrary, responses varied radically from region to region. The illustration below shows the regional percentages of men and women who failed at detection. In each region a majority of participants called themselves white.

Why these large differences? Why would responses from U. S. residents vary so widely from those of African residents when the ancestors of most of the respondents came from Europe? Why a significant difference between British citizens and their neighbors

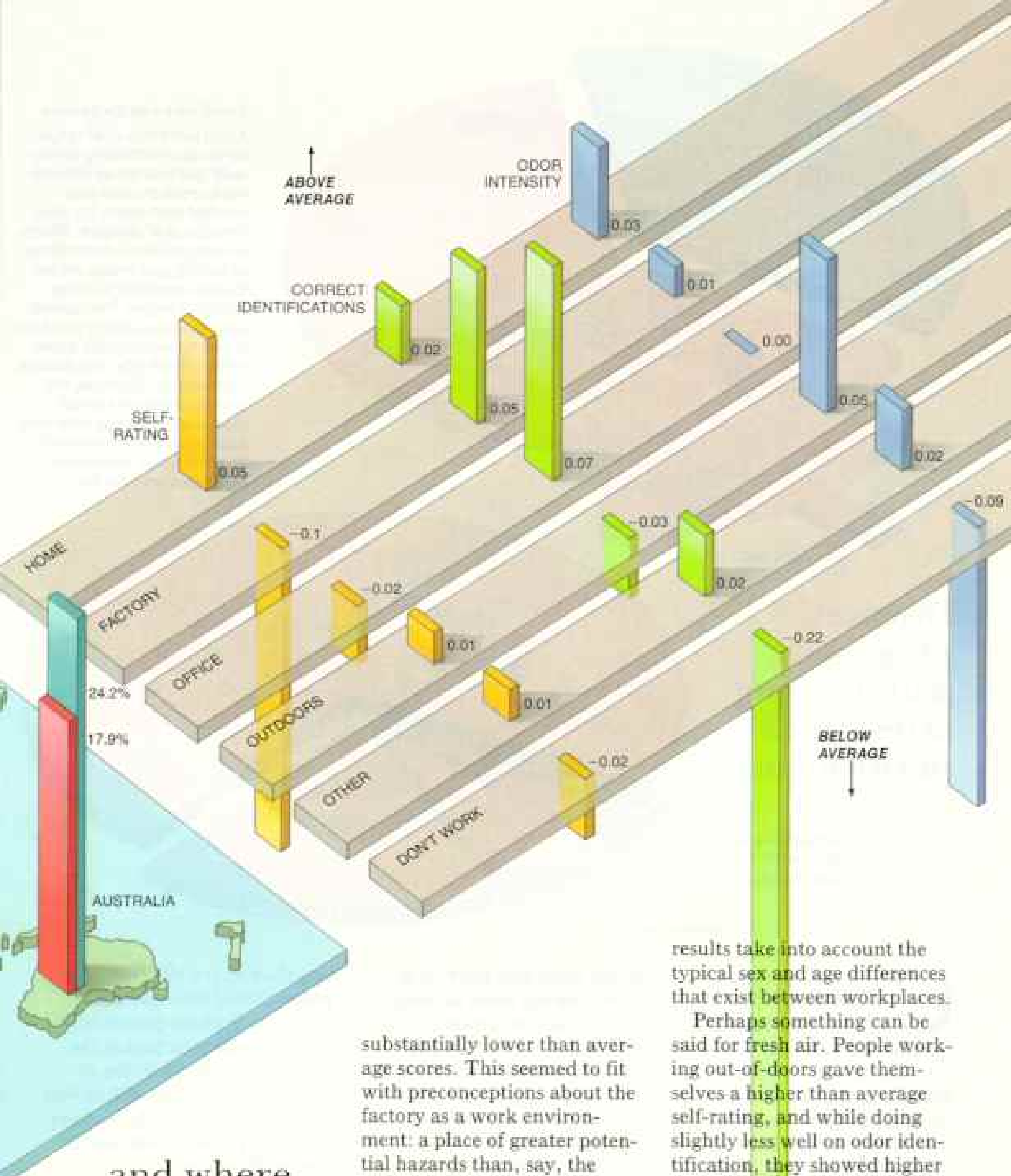
across the English Channel?

There are so many variables. Perhaps people in certain regions who had difficulty detecting the scents were less likely to return the survey. Or there may have been environmental effects on the different populations. We know, for example, that repeated exposure to androstenone can improve the ability to detect it.

All these findings are preliminary; we have just touched on a few of the many questions that await olfactory scientists in the immense body of data collected by the Smell Survey.







## ... and where you work

**W**HEN WE EXAMINED how participants rate their sense of smell in relation to where they work, we found that factory workers gave themselves

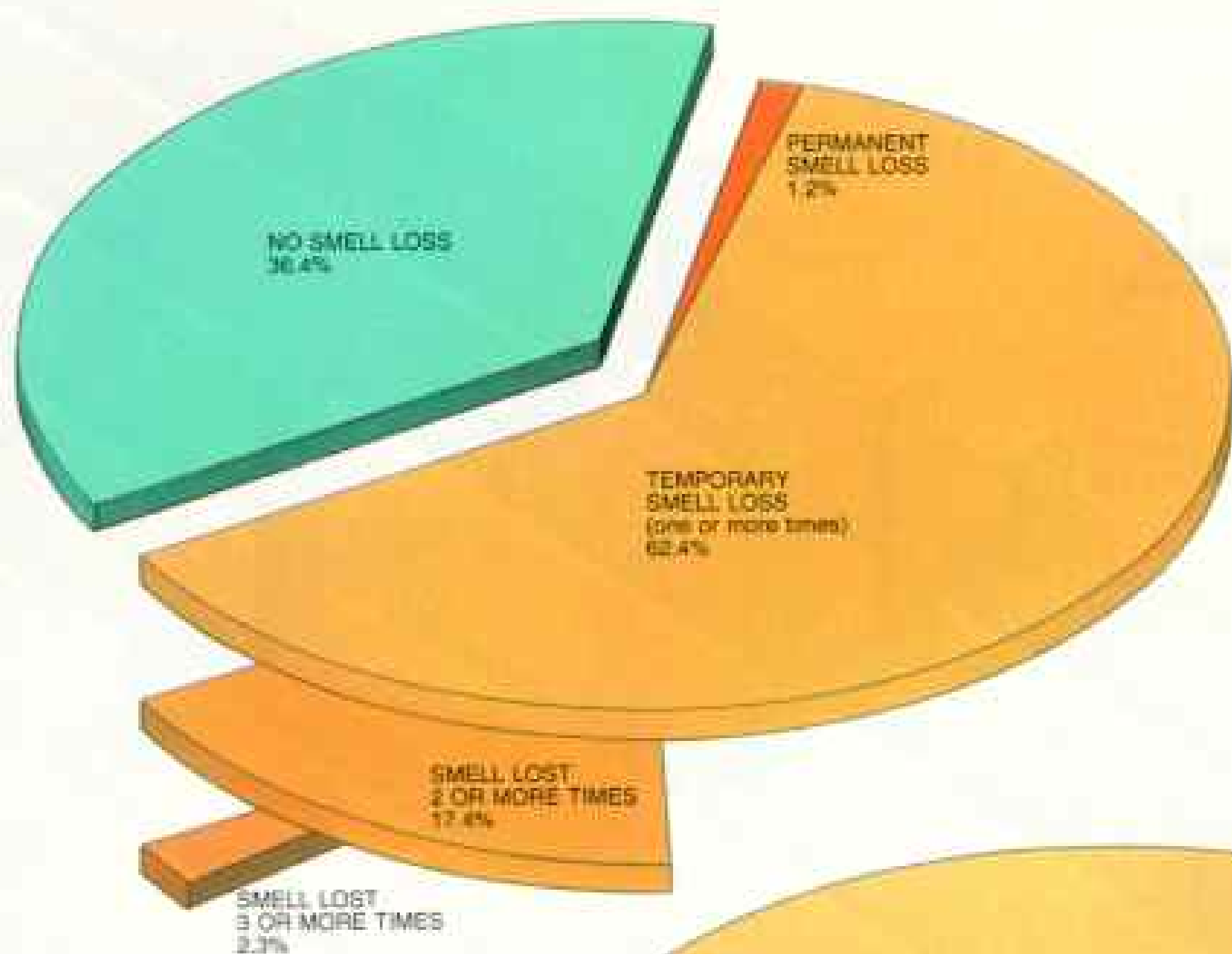
substantially lower than average scores. This seemed to fit with preconceptions about the factory as a work environment: a place of greater potential hazards than, say, the typical business office.

Both the preconception and workers' self-ratings were at odds with actual odor performance. Factory workers scored above average in identifying the odor samples, and they rated the odors as only slightly less intense than average. Keep in mind that these

results take into account the typical sex and age differences that exist between workplaces.

Perhaps something can be said for fresh air. People working out-of-doors gave themselves a higher than average self-rating, and while doing slightly less well on odor identification, they showed higher odor-intensity ratings.

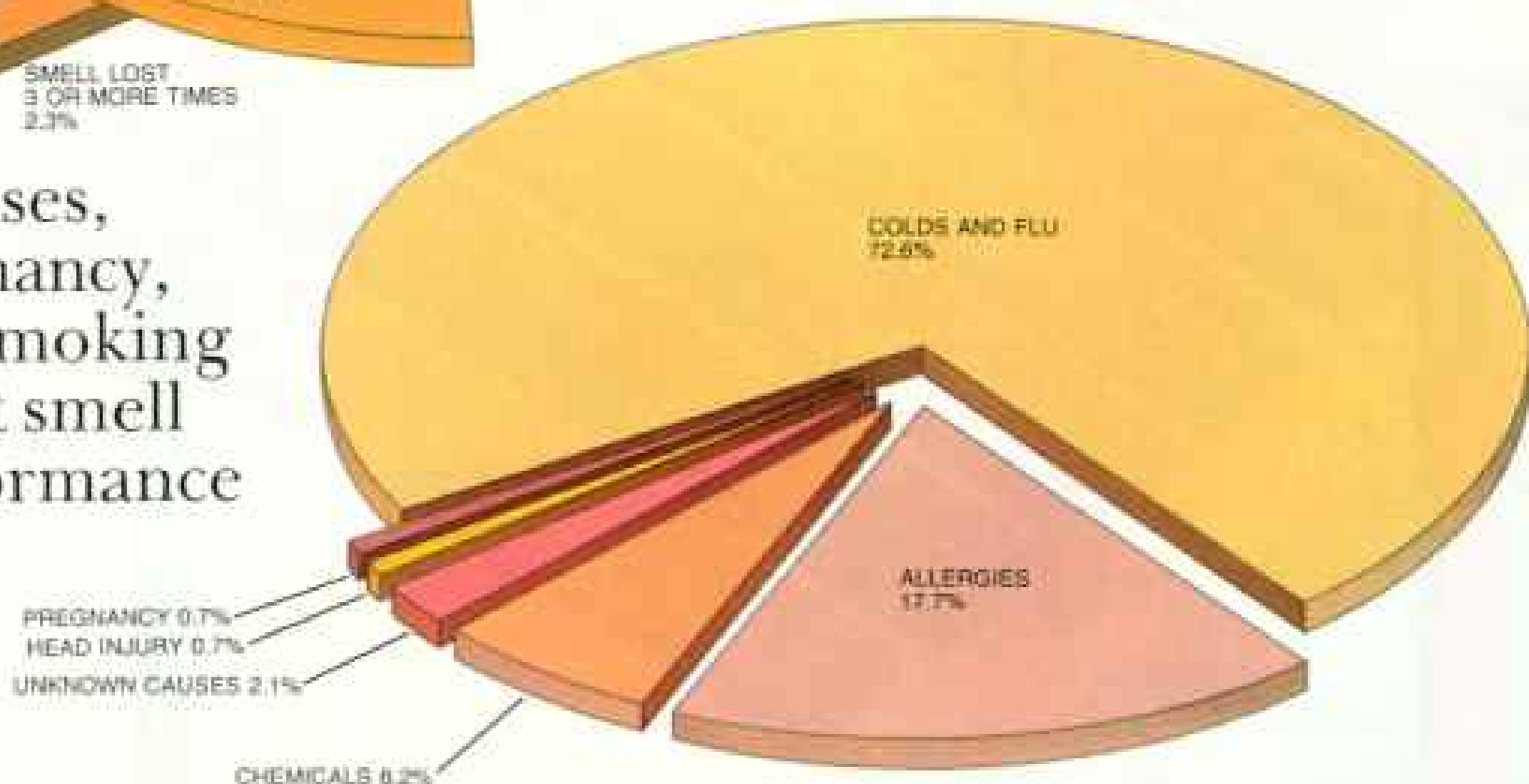
Another tantalizing, and currently inexplicable, finding involves those who characterized themselves as "not working." They turned out to be below average in smell ability on all counts—self-rating, odor identification, and odor intensity.



### Smell loss and its causes

About two-thirds of all respondents reported having temporarily lost their sense of smell. Most cases of smell loss resulted from colds, flu, sinus infection, and allergies. Allergy victims perceived themselves as having poor noses yet performed identically to those without allergies. Participants described recovery of smell lost during flu as occurring sometimes months after the disease. Exposure to chemicals, the next most frequent cause, presumably resulted from inhalation of vapors from solvents, cleaning fluids, pesticides, herbicides, and the like.

## Diseases, pregnancy, and smoking affect smell performance



CONSIDER A WORLD in which nearly two-thirds of the inhabitants had experienced temporary blindness. A strange place indeed. And yet 62.4 percent of survey respondents reported at least one temporary episode of smell loss, in most cases because of flu, common cold, or sinus infection. An additional 1.2 percent suffer permanent loss.

What can be responsible for a seemingly unexplainable loss of this sense? Smell is an exquisitely sensitive sensory system: A very small disruption in normal functioning elsewhere

in the body may have large effects on our sense of smell. Prescription medications, for example, can alter the perception of tastes and smells. Sometimes a change in olfactory experience is the only symptom in a patient who is otherwise healthy.

People with allergies rated their sense of smell lower than did allergy-free respondents. Despite this lower self-rating, we found little evidence of poorer performance on the actual test; on average, those with allergies could detect and identify smells as well as could allergy-free people

and showed few differences in perception of odor quality or intensity. Perhaps people with allergies who took part in the survey were not suffering at the time; their lower self-ratings may reflect an average of many temporary smell losses due to allergic flare-ups.

In contrast to allergy sufferers, participants with arthritis, diabetes, hypertension, or ulcers did not have a lower self-rating of smell. And none of these afflictions appeared to alter smell performance.

It is widely believed that sensitivity to smell increases during pregnancy. Indeed, the

majority of mothers who wrote letters about their experiences reported an increased sensitivity to all odors, usually with unpleasant consequences.

But survey data suggests that olfactory sensitivity may be reduced rather than heightened during pregnancy. In the United States, three of the odors (banana, androstenone, and musk) were rated less intense by pregnant women than by nonpregnant women of similar age. Further, pregnant women rated their own sense of smell slightly, but significantly, lower. Abroad, pregnancy seemed to have fewer effects: Androstenone was detected less often, and rose was rated less intense. This apparent discrepancy between U. S. and foreign respondents may be resolved by further analysis of the 1.5 million returns.

Perception of odor quality also seemed to be affected by pregnancy. Banana and musk were less pleasant, and androstenone less unpleasant.

Yet, based on the conventional wisdom about food cravings, banana should have been more pleasant.

Pregnancy was one of the least common causes of smell loss; it was reported by 1.6 percent of women. At least 96 percent later recovered.

Nearly 50 million Americans smoke tobacco. Does the habitual inhaling of hot smoke adversely affect their sense of smell? Certainly smokers think so; only a quarter of them identified themselves as having an "excellent" sense of smell.

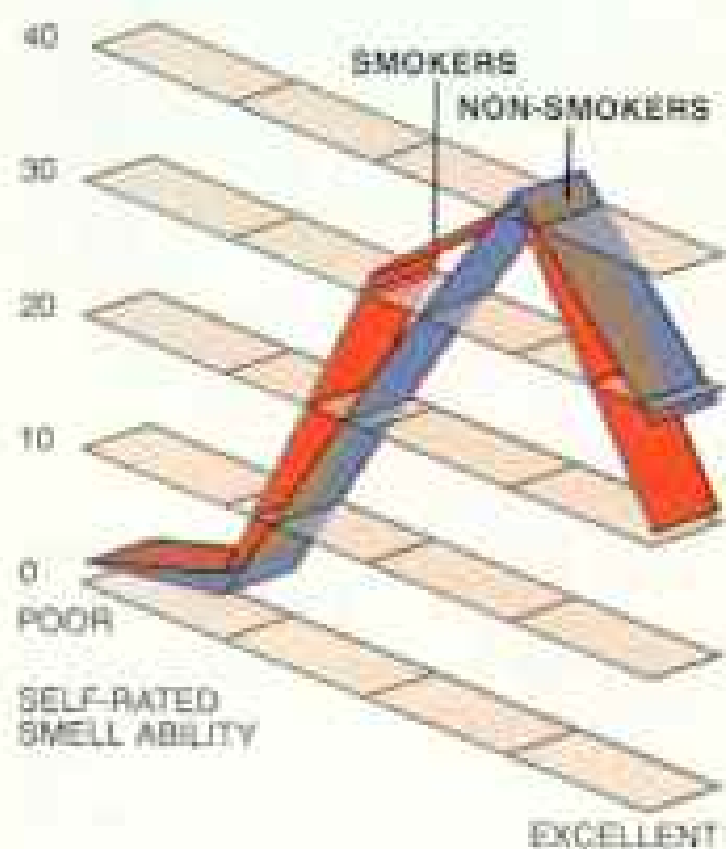
Unlike past studies, which typically compared how well smokers and nonsmokers could detect extremely low levels of odor, the survey took a new tack. It asked about smoking habits while measuring response to smells well above sensory threshold.

Perception of every odor but one was affected by smoking: Androstenone, cloves, and gas rated weaker, banana and musk stronger.

This curious mixed pattern may have to do with the reduced levels of nasal irritability previously reported in smokers. We also noted that smokers had a blunted response to odor quality; in general they found unpleasant odors to be less unpleasant, pleasant odors less pleasant.

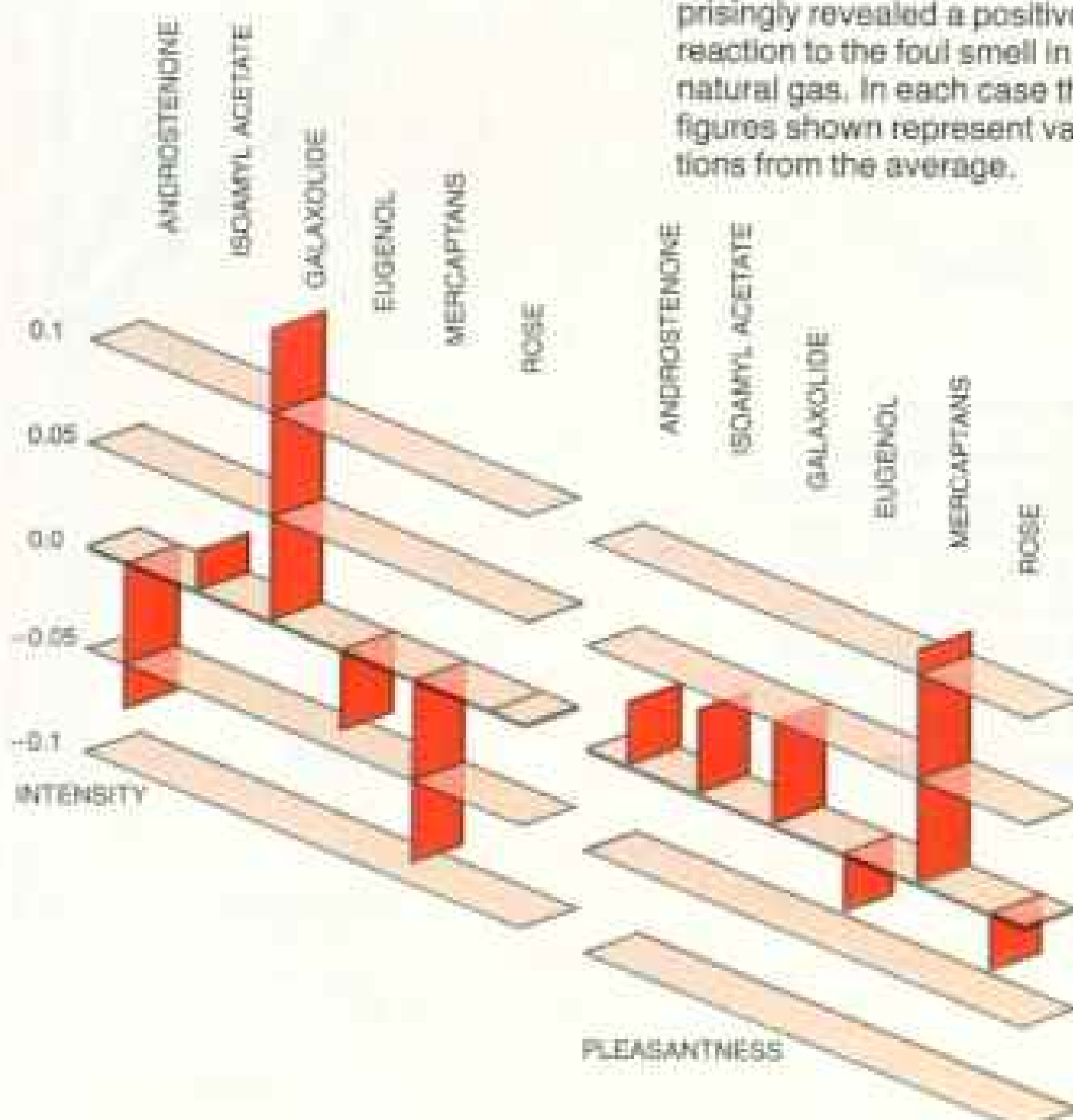
We suspect the explanation will lie in the relationship between nerve cells in the nose and information reaching the brain. Regardless, it would appear that smoking has an impact on the sense of smell, and thus, potentially, on a smoker's quality of life. Interestingly, among U. S. survey participants 40 percent fewer smoke than among the total U. S. population of similar age.

PERCENT OF PEOPLE RESPONDING



#### Smoking and smell

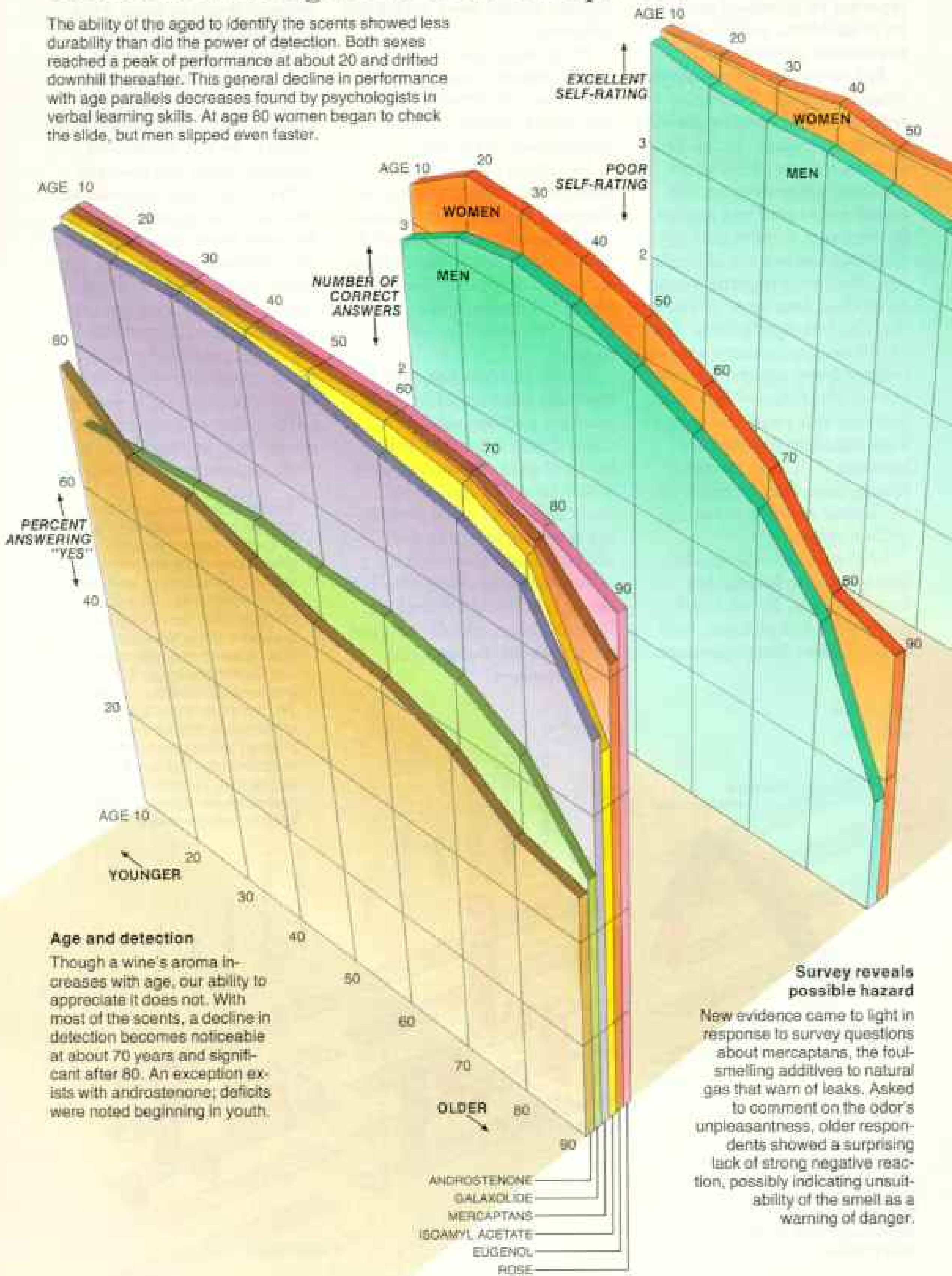
Respondents who smoke were less confident about their capacity to smell. They consistently rated themselves lower than did nonsmokers, and in many cases their performance bore this out.



Smoking had mixed effects on the way respondents reacted to the test odors. Smokers found Galaxolide more intense than did nonsmokers, while the reverse occurred with androstenone. This raises interesting questions about the relationship between androstenone and Galaxolide (page 516) and possible effects of smoking. Tested on pleasantness of the odors, smokers surprisingly revealed a positive reaction to the foul smell in natural gas. In each case the figures shown represent variations from the average.

# The effects of age: not bad, except. . . .

The ability of the aged to identify the scents showed less durability than did the power of detection. Both sexes reached a peak of performance at about 20 and drifted downhill thereafter. This general decline in performance with age parallels decreases found by psychologists in verbal learning skills. At age 80 women began to check the slide, but men slipped even faster.



## Age and detection

Though a wine's aroma increases with age, our ability to appreciate it does not. With most of the scents, a decline in detection becomes noticeable at about 70 years and significant after 80. An exception exists with androstenone; deficits were noted beginning in youth.

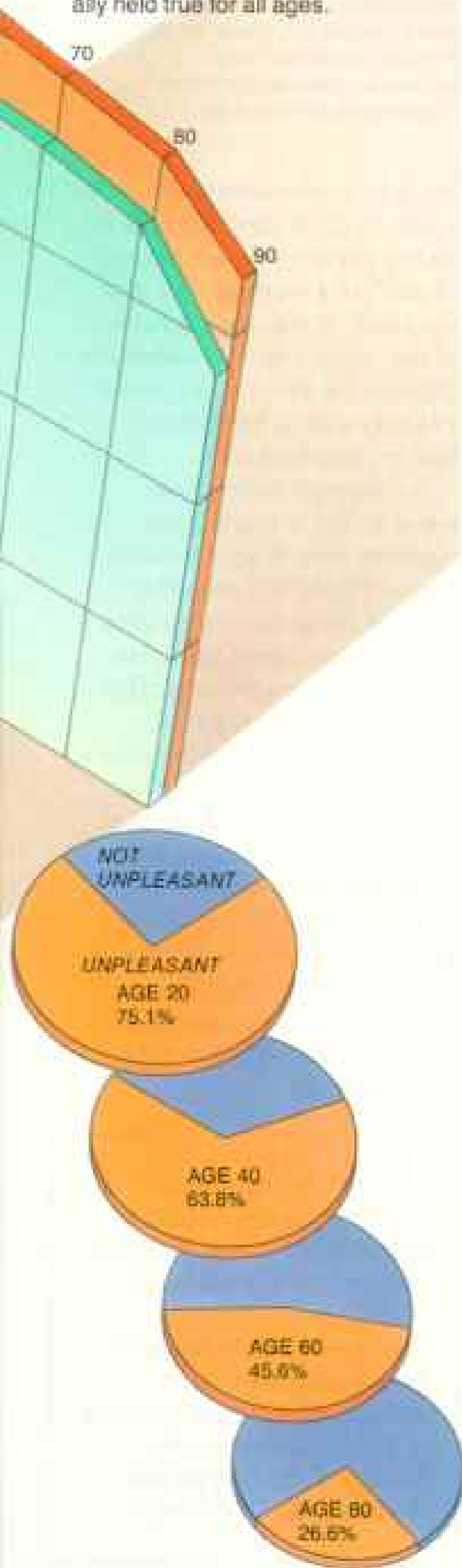
## Survey reveals possible hazard

New evidence came to light in response to survey questions about mercaptans, the foul-smelling additives to natural gas that warn of leaks. Asked to comment on the odor's unpleasantness, older respondents showed a surprising lack of strong negative reaction, possibly indicating unsuitability of the smell as a warning of danger.



### How we rate ourselves

Age proved to be no discouragement when participants were asked to evaluate their own ability to smell. Between the sexes, men seemed to recognize their limitations, while women correctly laid claim to having keener noses. This female superiority generally held true for all ages.



**D**O WE LOSE the ability to smell as we age? Although time may dim our other senses, the olfactory system apparently replaces sensory cells regularly, perhaps imparting resistance to the ravages of time.

True enough, age brought with it little decline in smell ability among respondents. Detection ability remains near youthful levels well into the seventh decade.

Once an odor is detected, is it perceived the same with increasing age? Clearly not. Odor intensity declined slightly and slowly, beginning, surprisingly, in the third decade. The ability to describe the odors accurately also began declining fairly early in life.

The most dramatic case of an age-related change was associated with natural-gas odor. Gas companies add foul-smelling compounds known as mercaptans to their normally odorless product as a warning signal; they have worked hard to develop an odor that is generally repugnant. Disquietingly the proportion of readers rating it very unpleasant plunged with age.

In contrast, the pleasantness ratings of other odors remained constant with age.

The test result with gas, of obvious relevance to public safety, also raises a more general question: Do all foul odors grow less unpleasant with age?

Apart from gas odor, it appears that a reduced ability to identify odors does not necessarily alter the pleasantness of odors. And while a limited number of people completely lose the ability to smell an odor, a gradual reduction of intensity of odors is a common feature of aging. A rose is a rose, except, perhaps, after the age of 65. . . .

*"After my husband died, I would go into his closet and hug his suits, because they smelled of his own body odor, slight cigarette smell, and aftershave. I'd stand there, hugging his clothes, making believe, close my eyes, and cry."*

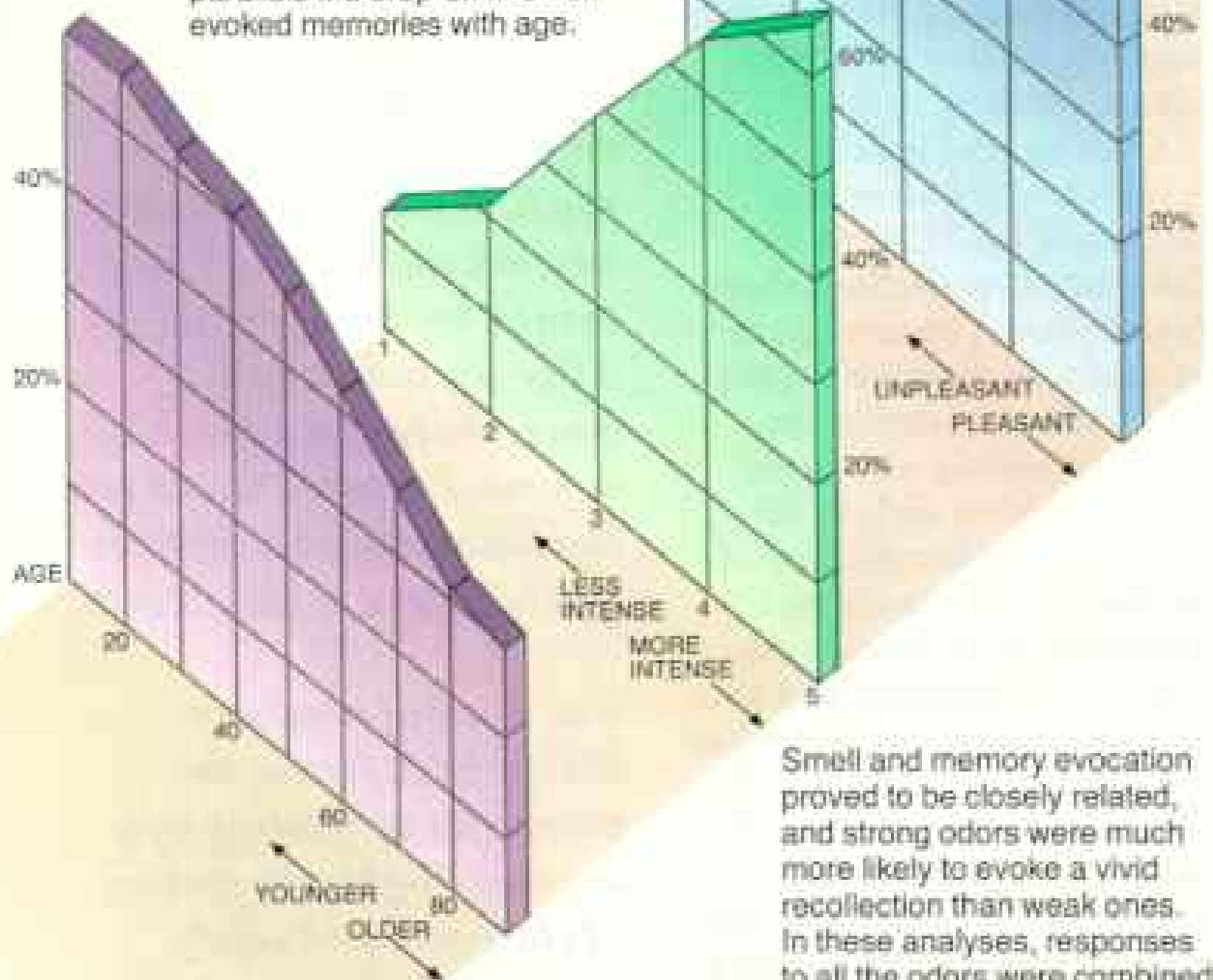
*"Over my lifetime I have enjoyed a good sense of smell. When I was a young boy, my mother had entertained her bridge club. After the ladies had gone, she found a glove left behind. I smelled it and told her what lady to call to see if it belonged to her. It did."*

*"The smell of kerosene brings back for me the memories of reading by a kerosene light, the feeling of closeness and safety and the shadows cast on the walls, the laughter of a grandmother dead almost 30 years."*

*"One of the most evocative smells in my experience is the odor of NATIONAL GEOGRAPHIC magazines. Taking a whiff of one always brings the memory of childhood hours poring through the stacks of GEOGRAPHICS in my parents' basement."*

# Did the odor evoke a vivid memory?

Memories kindled in the aged by odors from youth form an accepted part of our folklore. But results of the survey challenged this belief. An explanation could lie in the reduced ability of older persons to identify odors, which closely parallels the drop-off in smell-evoked memories with age.



Smell and memory evocation proved to be closely related, and strong odors were much more likely to evoke a vivid recollection than weak ones. In these analyses, responses to all the odors were combined in order to derive the curves of the graphs.

**S**MELLS, the poets say, occupy a privileged place in memory, able to rekindle old recollections often full of emotion. But before the survey there was a paucity of data with which scientists could test these lyrical claims.

In this interest we used the survey to obtain unique data about the memory-evoking power of smell. We found that the stronger the odor, the more likely it was to bring to mind a vivid memory. And just as women found all odors stronger, they also reported more memories than men for every odor but gas.

Are foul odors as likely to evoke a memory as pleasant ones? They are. As it turned out, extremely pleasant and

extremely unpleasant odors were both more likely to evoke memories than odors with only a so-so rating.

These numerical results jibe nicely with letters we received describing episodes of odor-triggered memory. By and large these were pleasant, brought on by pleasant odors. A Coloradan wrote:

"One of my favorite smells is cow manure. Yes! It brings back memories of me on my aunt's farm in southern Ohio. The vacations I spent there were the happiest of my childhood, and any farm smell evokes wonderful memories."

Odors that were identified correctly were much more

Important new understandings emerged in comparing the pleasantness of an odor and its capacity to kindle memory. Participants' memories were stirred by smells they regarded as either pleasant or unpleasant rather than by those they considered neutral. This raises new questions: Did the pleasantness of the recollection cause the odor to seem pleasant? Or vice versa? And can a pleasant odor evoke an unpleasant memory? These await further study.

likely to evoke a memory, often a very specific one. Sample 6 on the survey was not merely "floral" to a woman living in England; it was the perfume of the "deep red rose called Dr. Charles De Bat," last smelled 19 years ago in her father's rose garden in Africa.

A frequent claim about scent is that it can trigger memory over many decades. For a 77-year-old man the smell of air brakes summons up Saturday-morning street-car rides to downtown Indianapolis, when Grandma would treat him to a chocolate soda at an ice-cream parlor. But survey results show that odor-evoked memories fade gradually with age.

Finally, the lingering odor of NATIONAL GEOGRAPHIC's ink brought to mind in more than one reader memories of childhood hours spent with the magazine.

**T**O PROVIDE maximum access to survey results, as of January 1, 1988, National Geographic is making all of the data available at reasonable cost to bona fide researchers. Applicants should address their requests to National Geographic Society, P.O. Box 37138, Washington, D. C. 20013.



BILL BALLEWENS

*UNEXPECTED CELEBRITY* came to Thelma Williams and her colleagues, who were pictured in "The Intimate Sense of Smell" (September 1986) testing a deodorant by first sniffing the natural odor of volunteers. Media from around the world converged on Hill Top Research, Inc., at Cincinnati, Ohio: TV crews from Japan, magazine photographers from Europe, reporters from across the nation. Said the 37-year veteran with Hill Top: "I was able to persuade all of them about the seriousness of our research."

## Smell problems and where to seek help

**M**ANY RESPONDENTS sought our advice for their smell disorders. Because of the wide range of possible causes, we generally recommend a thorough physical examination.

As attention is focused on disorders of smell and taste, a number of federally funded centers have been established.

One of these, associated

with our center, is the Monell-Thomas Jefferson Hospital Taste and Smell Clinical Research Center in Philadelphia. Others are the SUNY Health Science Center in Syracuse, New York; the Hospital of the University of Pennsylvania in Philadelphia; the University of Colorado in Denver; and the University of Connecticut Health Center in Farmington.

Despite new efforts in diagnosis, medical treatment for smell disorders is limited. When smell loss results from nasal polyps, surgery can help. But when sensitivity suddenly

is lost following the flu, for example, not much can be done.

Fortunately, spontaneous recovery can occur. A 74-year-old Indiana woman recalls:

"I was born with an extremely keen sense of smell. It enriched my life immeasurably. I didn't know how much until I suddenly lost it one day in my late forties. . . . After three years, I stepped outside one day and smelled that wonderful smell that precedes an April rain. I think it was a poet who spoke of joy unconfined. In that moment I felt just that." □

## *The 20th Century Comes to Shangri-la*

# Baltistan

BY

GALEN ROWELL

PHOTOGRAPHS BY THE AUTHOR AND  
BARBARA CUSHMAN ROWELL

**T**HE OLD MAN wore the simplest cottons, faded from long use and countless washings. His skin was as parched and brown as the slopes above his high pasture in Baltistan's Karakoram Range. Only the old man's eyes, twinkling like diamonds behind thick glasses, hinted that this was no ordinary farmer.

My friend Shah Jehan introduced me: "Galen Rowell, meet Wazir Ghulam Mahdi. He is one of our land's very few scholars. He has a law degree and a master's degree in history, both earned in British India, and he has served in our national assembly. But he prefers the quiet life of farming."

The old man smiled. "That is so," he said in careful English, "but my education is notable only because Baltistan is such a small and backward place."

I asked him then why he chose to live here, so far from the cultured surroundings of his earlier days. In answer, he swept a hand around him, at golden shafts of sunlight beaming through the mountain haze, at emerald stalks of young barley sprouting in the fields, at evening clouds hovering pink in the fading light above distant snow peaks.

Wazir Ghulam Mahdi is right: His is a land of great beauty. There is a mystical, Shangri-la quality about Baltistan, the lofty and remote northeastern district of Pakistan

that borders on both China and Indian-held Kashmir (map, page 532). For centuries the Karakorams and Himalayas so insulated Baltistan that the country became a cultural fossil—a timeless imprint of great civilizations that had touched there.

"Our language is unwritten and our history and our deeds are passed down from father to son," Wazir Ghulam Mahdi told me. "Dates are not important to us; few Baltis even know the year of their birth."

Until the late 16th century Baltistan was just another small mountain kingdom whose strongest defenses were its high altitude, its cold, and its vast isolation. Then the legendary Balti hero, Ali Sher Khan, rose to power and won control over the surrounding kingdoms, from Chitral on the west to Ladakh in the east. He married a Mogul princess from India named Mindok Gyalmo and continued to expand his empire.

"While Ali Sher Khan was off in battle," Wazir Ghulam Mahdi told me, "Queen Mindok imported sculptors, artists, and engineers from Delhi. She laid out magnificent gardens in the royal city of Skardu, built a great aqueduct system to irrigate Skardu Valley, and constructed a road up a steep cliffside to a fort overlooking the city.

"When Ali Sher Khan returned, he told her: 'You have built an aqueduct, and for that you should' (Continued on page 532)

*Sharing a private moment with her son, a Balti woman in the village of Askole faces a world of change. Her tradition-bound people, isolated among some of the world's highest mountains, are rapidly being drawn into modern Pakistani culture.*

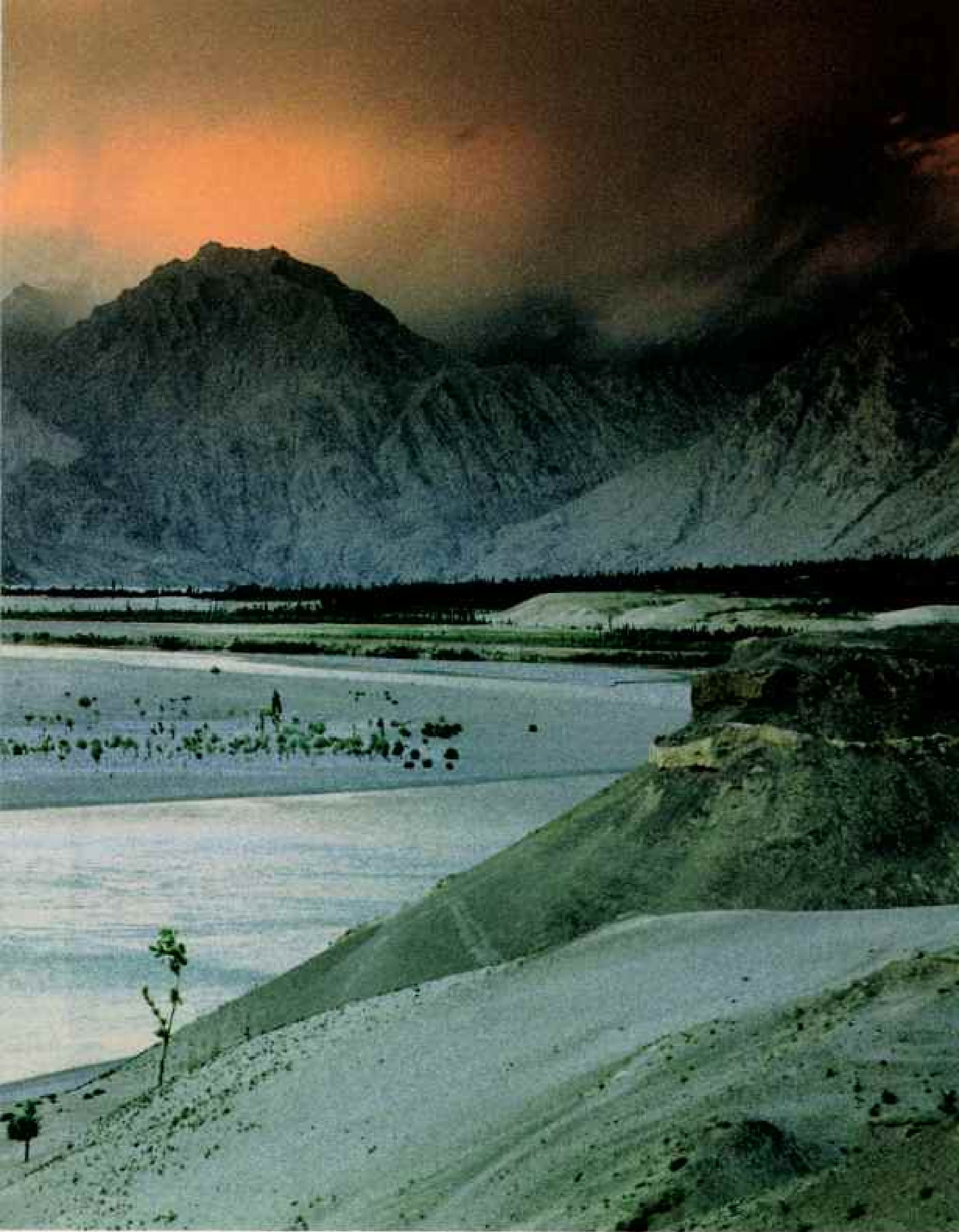




BARBARA CUSHMAN ROSELL

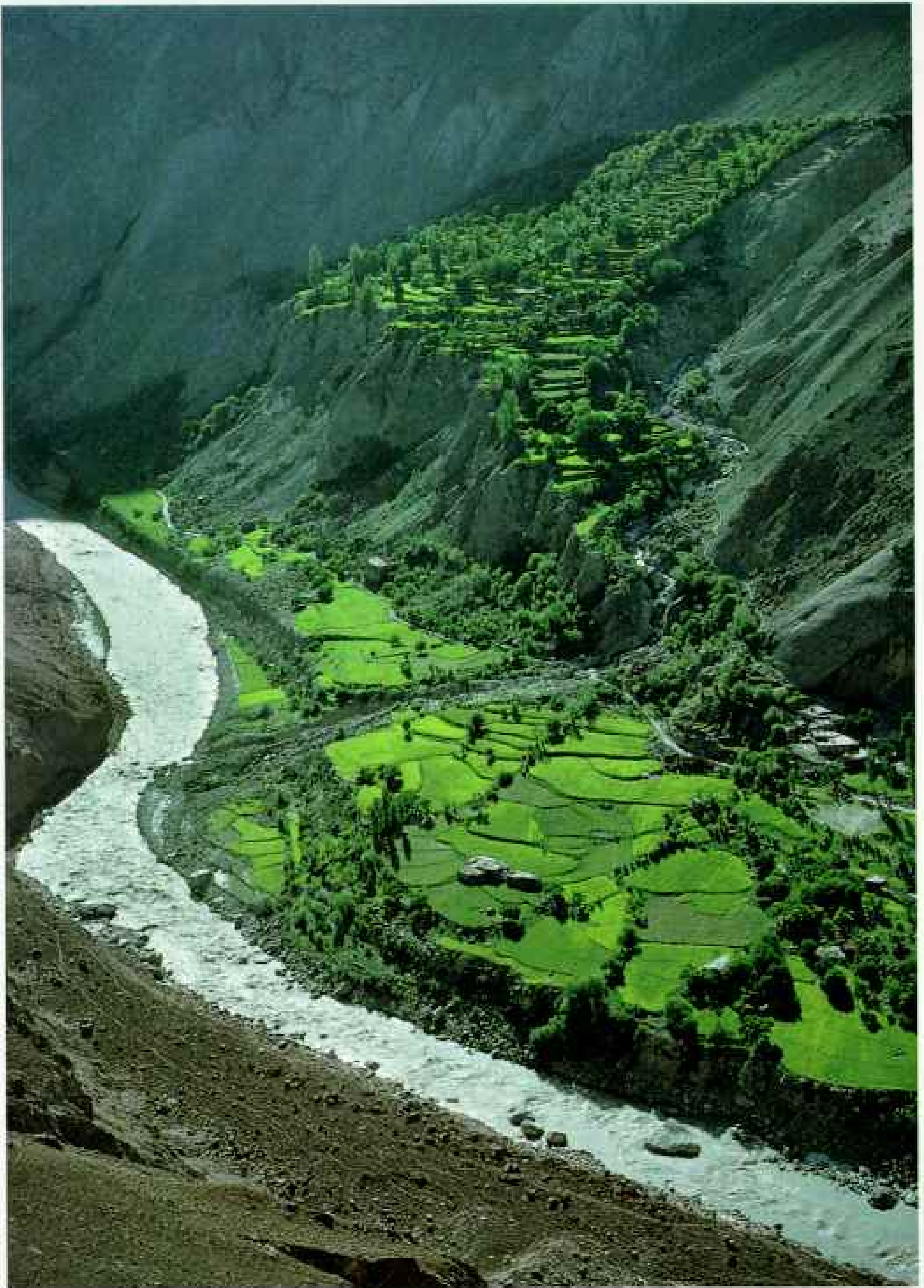


*Born in ice, the Indus River flows through the Skardu Valley, carrying meltwater from glaciers as far away as Tibet. The breathtaking peaks of the Karakoram Range tower more than 9,000 feet above the valley floor. In summer the Indus*



can spread as wide as five miles, covering most of the valley seen here. Taking advantage of the river's fertile floodplain, residents of the town of Skardu cultivate apricot, apple, and peach orchards in the sandy soil.





*Only way to get there for now, a foot trail wedged into the side of a cliff takes travelers from Skardu to the high valleys of the Braldu River. Five Baltis fell to their death while the author was in the area. A new jeep road skirts the floor of a gorge along the river (above), but no vehicle can use it until bridges are added. Terraced fields of barley, watered by a single aqueduct, spill down the canyon wall.*





# Baltistan

*Region in conflict*



NES CARTOGRAPHIC DIVISION; DESIGN: J. LITHEIS; RESEARCH: B. MILLER; PRODUCTION: K. GOODE, I. BRADY

Claimed by both India and Pakistan since their independence in 1947, the 10,000-square-mile region known as Baltistan (population 224,000) is part of the disputed territory of Kashmir. The two nations have battled three times over Kashmir, in 1947-48, 1965, and 1971. Today they are skirmishing for control of the uninhabited Siachen Glacier area.

(Continued from page 526) be rewarded. But you have also constructed a path for my enemies to my fort, and for that you should be hanged!"

The queen's life was spared, but she died soon afterward of a broken heart. All that remains of her great works today is the aqueduct. After Ali Sher Khan's death his empire languished, and Skardu reverted to the quiet ways of centuries past.

The close of World War II brought massive change to the Indian subcontinent. With the end of British rule Baltistan, which was inhabited largely by Muslims rather

than by Hindus, became disputed territory.

"As Muslims we refused to remain part of India and chose to join the new nation of Pakistan," Wazir Ghulam Mahdi explained. "We fought a bitter war of liberation in 1948 and defeated the troops India sent against us. We consider ourselves part of Pakistan today, though technically we are still disputed territory and cannot even vote in Pakistan's national elections. In fact, Baltistan is the front line in the struggle between Pakistan and India over territorial claims."

Some weeks later my wife, Barbara, and I were to have a closeup view of that front line



and the casualties that constantly occur along it. For the moment, however, we bade Wazir Ghulam Mahdi good-bye and made our way by four-wheel-drive vehicle to nearby Skardu, Baltistan's capital and largest town. Here some 25,000 residents face a variety of changes that threaten to overwhelm their homeland.

I first visited Skardu in 1975 on a mountaineering expedition and have made five more trips there over the years. In 1975 the community was little more than an overgrown village, where vehicles were so rare that residents actually fled like startled animals at the sound of an engine. Nowadays at a busy downtown intersection constant streams of cars, trucks, tractors, motorcycles, and army vehicles pour in and out of a crowded bazaar.

One sees the army vehicles at more ominous times, often before dawn as they roll out of Skardu with Pakistani troops bound to the east for the border area with Kashmir. There in 1983 India secretly occupied the Siachen Glacier. A border war ensued that continues to this day.

At stake is terrain so steep, lofty, and cold that until recently it was uninhabited. Yet troops now live year-round at altitudes as high as 20,500 feet, where winter temperatures can reach minus 60°F.

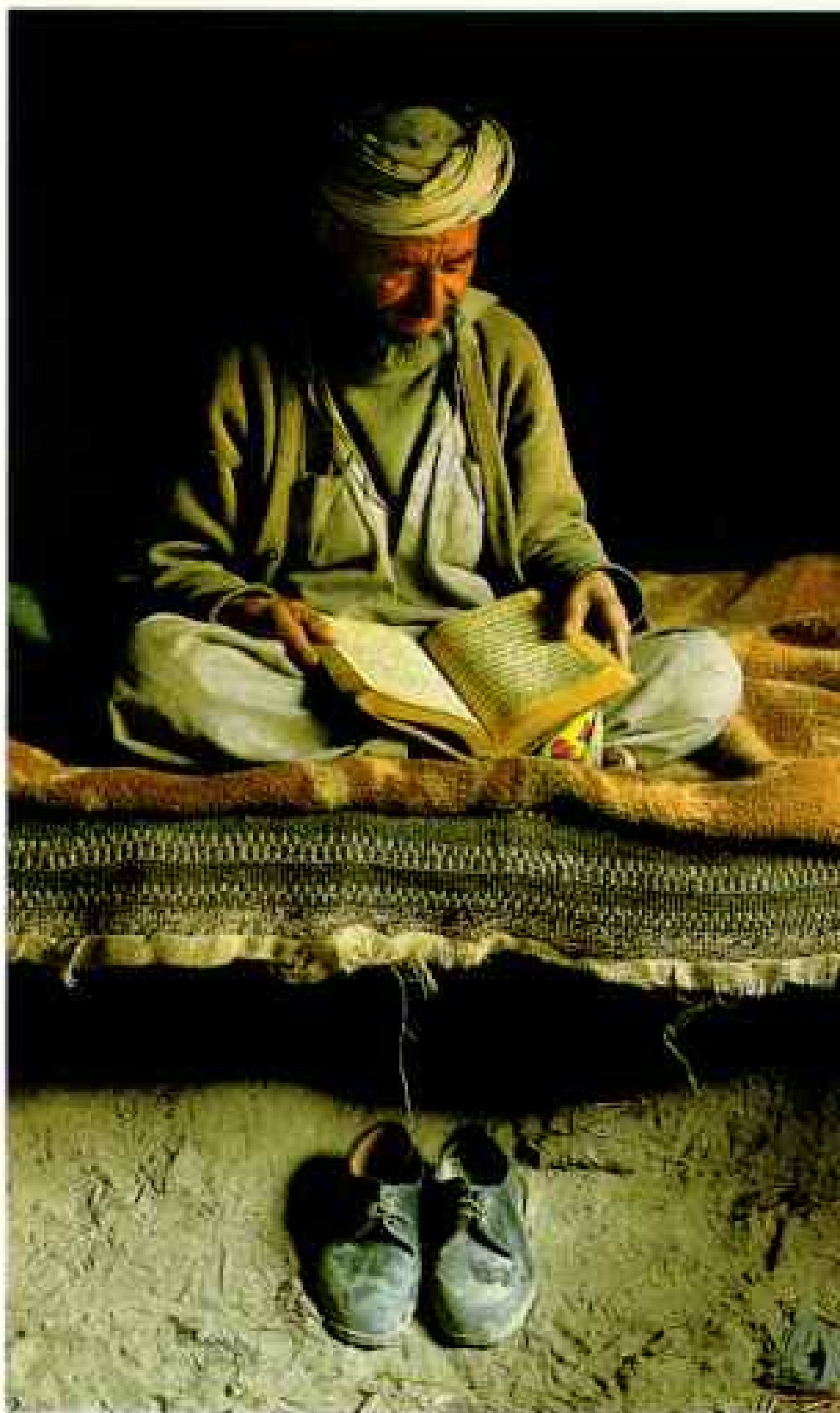
"We're fighting two enemies, India and nature," a captain in the border war told me. "India occupies the territory, but nature rules it. So far we are even with India, but nature is far ahead—we have lost many more men to avalanches, crevasses, and cold than we have to shells and bullets."

**A** PEACEFUL and far more successful invasion is taking place in Baltistan today. One evening over tea in Skardu a group of friends described the changes that are fast overtaking their land.

"Transportation is a big factor," said Shah Jehan, who had introduced me to the old farmer and who works for Pakistan International Airlines. "When you were here in 1975, you flew in and out of Skardu by propeller aircraft—that is, if the weather allowed you to." I agreed that was so.

"That era began back in 1953, and it will end next week," he said. "On Wednesday

*Man of learning and of faith, Hajji Ali reads the Koran in Arabic at his home in Chongo. Most Baltis are Shiite Muslims. The Balti language, an archaic form of Tibetan, is unwritten.*



we begin jet service with Boeing 737s that will fly over the Himalayan weather instead of through it. With 300 scheduled flights in and out per year the effect on tourism—and our economy—will be enormous."

"The same thing is happening on the ground," added Haibat Ali, manager of Skardu's K2 Motel. "Now that it's paved, the Indus Highway brings increasingly heavy traffic in passengers and goods from Islamabad. And since May of 1986, when the Karakoram Highway was opened all the way to China, traffic comes from there as well."

*To fight the chill of early morning, children huddle on a rooftop in Askole, at 10,200 feet the highest village in the Braldu Valley. Much of the day may be spent on such a rooftop, as residents spin wool, sift grain, dry apricots, or socialize.*

"Meanwhile," remarked Pervez Khan, a photographer friend, "the Baltis have discovered the foreign marketplace. More and more of them are signing up as contract laborers in Middle East oil countries for a year or two. They come back with enough money to buy a truck and start a small business."

The changes brought about by this new worldliness have begun to spread far beyond Skardu into Baltistan's high valleys and mountain villages. It is only a matter of time before they reach Askole, and something unique will be lost.

Askole is the highest village below K2, the 28,250-foot peak that is second only to Everest in height. I came to know Askole well in 1975 as a member of an American team led by Jim Whittaker that failed in its first attempt to conquer the peak but succeeded three years later.\*

**I**T WAS AT CONCORDIA, between Askole and K2, that I scattered my 90-year-old father's ashes. Despite his age, his death in California had come suddenly. He was a great lover of mountains all his life, and he had taught me to love them as well. My mother, never one to bother with red tape, simply packed up his ashes and sent them to me by air with a note: "Spread these in the most beautiful place you can find." Concordia, named by British explorer Sir Martin Conway for its confluence of glaciers, is often called the most magnificent scene in the Karakoram. I knew my father would have approved the choice.

Today a narrow mountain road is under construction toward Askole, but the route is not yet complete. Nearly half of the 85 miles between Skardu and Askole are wild and beautiful foot trails through the great Braldu Gorge.

When Barbara and I reached Askole, some 50 of the 300 villagers turned out to greet us with shouts and hugs. Among them was an old friend, Hajji Jaffar, who had



served as head porter on the K2 expedition and who had earned the honorific title "Hajji" as a result of eight journeys to Muslim shrines in Saudi Arabia and Iran.

He ushered us into his home, which like other houses in Askole consists of one large central room with a cellar below and a hole in the roof for a chimney. Smoke from a dung fire inside nearly asphyxiated Barbara and me. The villagers are used to the fumes, but lifetime exposure results in considerable lung and eye disease among them.

Askole still observes the custom of *pardah*, or seclusion of women from the eyes of unrelated men. As a result Hajji Jaffar's

\*James W. Whittaker and James Wickwire wrote of the feat in "Americans Climb K2," in the May 1979 NATIONAL GEOGRAPHIC.





BARBARA CUSHMAN HOWELL

wife was veiled, and he did not introduce her to us. She served us lunch through the hands of her husband, passing him dishes of hard-boiled eggs and chapati, or griddle cakes of unleavened bread.

Two children peered cautiously at us from the cellar, and I asked Hajji Jaffar how many he had.

"*Tschoo*," he replied, using what I thought was the Balti word for ten. But I know only a few words of that Tibetan language, so I asked again.

"*Tschoo*," he repeated, holding up ten fingers and added: "*Diving ksuum*—Today, three." Then he flashed seven fingers and drew a hand across his throat to indicate that seven of his children had died.

We had brought a friend, Nazir Sabir, a

guide from nearby Hunza who speaks fluent English. Though Nazir too is Muslim, he was troubled by conditions in Askole.

"Look at this village," he exclaimed. "One of its leaders is a man who has made eight pilgrimages abroad, yet seven of his children have died. For the cost of just two or three pilgrimages the whole village could have clean water piped from a spring instead of drawing water from drainage ditches where even the animals drink. No wonder so many children die."

Askole's solution, like that of other Balti villages, is for the wives to produce as many offspring as possible throughout their child-bearing years. Only that way can a village combat the appalling infant mortality rate and the lower fertility levels at high altitude.



BARBARA CUSHMAN ROWELL

*Hazardous to health, dense smoke from a small fire of twigs and animal dung fills a living room (above) in Askole. Like most Balti homes, this one has no chimney, since heat would escape and fuel is scarce. Breathing such smoke aggravates the incidence among residents of tuberculosis and other lung and eye diseases. Partly as a result, Balti children suffer a high rate of mortality. This man's brother has lost seven of his ten children.*

*Lack of iodine in the Balti diet makes goiters (left) a common sight. The government provides iodized salt in Skardu markets, but villagers often use raw rock salt, such as that being purchased (top left) at a local shop.*



ONE AFTERNOON as I took a stroll through the village, I noticed a slender veiled woman staring boldly at me across a courtyard wall. Her hair was braided and tasseled Askole style, but she had bright green eyes and extremely fair skin. Only when I got within a few yards did I recognize Barbara: The village women had made her up to be a Balti.

The gesture was proof of the wives' friendship toward Barbara. As a woman she had access to a side of Balti life forbidden to unrelated men, especially camera-carrying Westerners like her husband.

Barbara was deeply moved by her experiences and later described the women of Askole in her journal:

"Although outwardly poor," Barbara wrote, "these women have a sense of peace

and comfort that money can't buy. They spend their lives among families where several generations live under one roof and where no one is left alone or unattended, from the very young to the very old. Their easy laughter brings back memories to me of childhood slumber parties.

"While their menfolk follow herds, work as porters, visit other villages, or go on pilgrimages, the women cook, wash, carry water, milk the goats, sew, and do most of the work in the fields except for irrigation and plowing. When home, the men take a very active role in rearing sons, but if the first wife fails to produce a son, the man sometimes takes a second wife.

"Toys as we know them are never seen. If a little boy has a tiny hoe, it is for him to use with his father when they irrigate the fields



*Every trip is an adventure in Baltistan. On the main highway from Islamabad to Skardu, a truck carrying vegetables rolled onto its side when a stretch of roadbed collapsed beneath it. Here workers struggle to right the vehicle, which narrowly avoided sliding down the mountainside into the Indus River.*

*Road building in Baltistan is slow and dangerous. Since work began in 1968 to pave the highway, hundreds of laborers have been swept away by landslides. A crew clinging to a cliff (bottom right) lays a foundation by hand for a new*

*road between the Skardu Valley and the Deosai Plains to the south. Until the highway to Islamabad was completed in 1981, the only road out of Baltistan led to Indian-held Kashmir—a route unusable since 1947.*

*Near Askole, villagers repair a footbridge across the Braidu River, constructed from willow vines only two or three feet long. When the new jeep road to the village is completed, it will inevitably bring changes—perhaps better medical care and education along with more tourists.*











together. Little girls carry around baby sisters instead of dolls. One girl I met was 13 when her parents married her to a 40-year-old man.

"I felt an inner conflict," Barbara continued, "wanting the women to know there is another way of life through education, that they could have freedom of choice and not have a husband forced upon them at an early age. But 'fulfillment' or 'consciousness-raising' would be misunderstood here. If I convinced one woman, she would only become a misfit among her people."

Askole's one schoolteacher, a slender Balti in his late 20s, takes a dim view of village education. "We have no schoolroom," he told me, "so I must teach in someone's house. I have only six students, though there are more than 40 boys of school age in the village. For the girls I can do nothing, since local custom forbids me to teach boys and girls together.

"Askole families," he said, "want their children to work in the fields, not waste time studying. Parents don't think of a child's future while life in the present is so hard."

**H**AJJI MAHDI, Askole's village leader, thinks the new road from Skardu will solve many of the problems of the village.

"Skardu is 85 miles away," he points out. "Goods brought from there by porter cost us dearly. Sugar, for example, costs nine rupees [55 U. S. cents] a kilogram in Skardu, but it costs 17 rupees a kilo by the time it reaches Askole. When things can be brought in by truck, life will be better for us all."

Perhaps, but not for Askole's wild inhabitants. Just before Barbara and Nazir and I left, a villager took me aside and whispered, "Snow leopard skin. Come my house, see. You buy, 10,000 rupees?"

The snow leopard is an endangered species now protected by international agreement.\* But for lack of funds the law is not enforced in the higher valleys of the K2 region, where snow leopards normally dine on the area's large stock of Siberian ibex. The leopards get in trouble when they come down to Askole for a fast-food meal of domestic goat. The villager who took me aside was offering a highly illegal item for \$600 with little risk of being caught or punished.

*Although forbidden to do so by law, a villager in Askole offers for sale the pelt of a snow leopard, an endangered species, for \$600—the equivalent of a year's income. The cat had killed a village goat.*

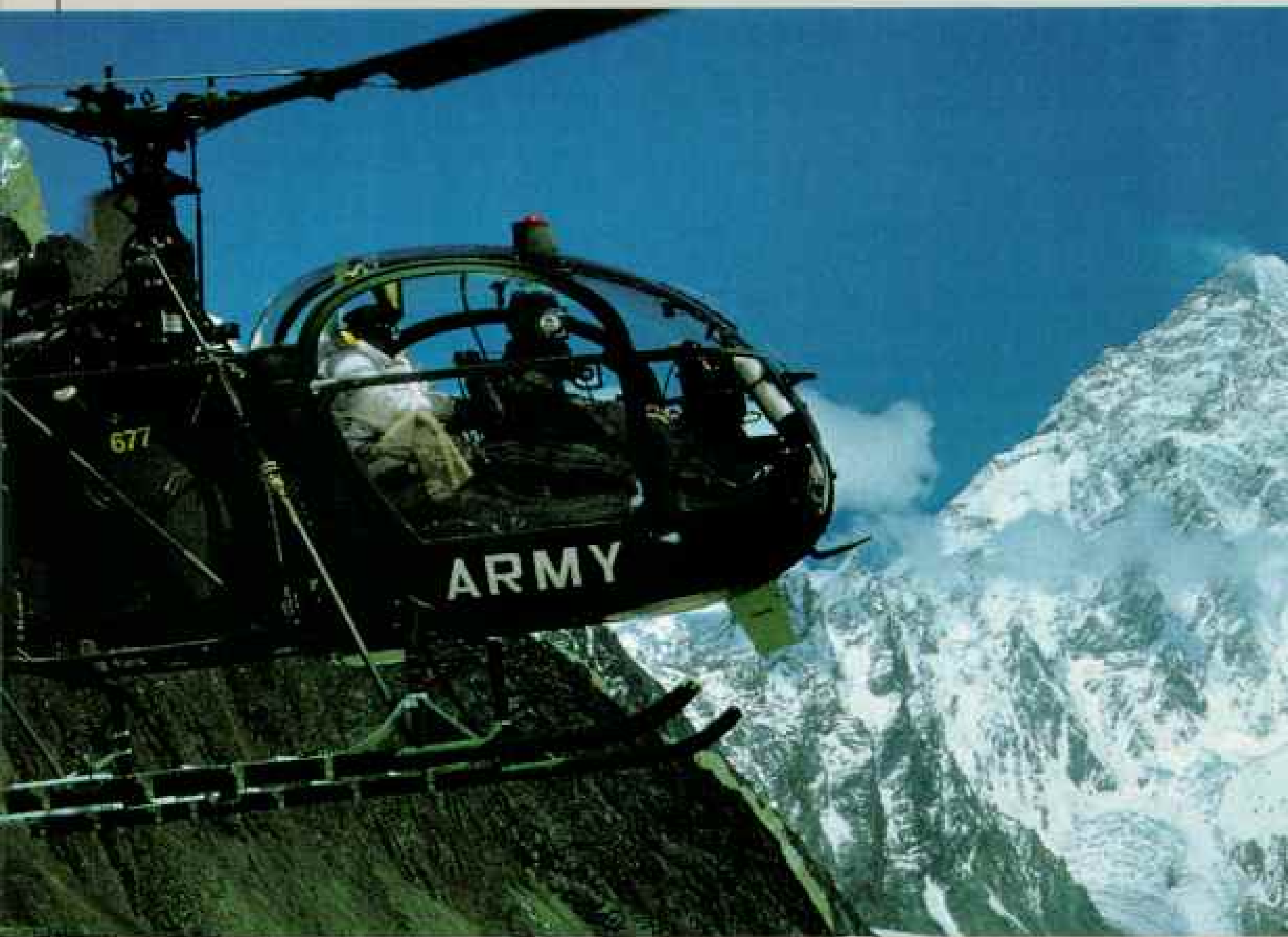
*Like a pipeline from the snowy peaks, the Braidu River carries meltwater to fields around Askole (facing page).*



When the Askole road is completed, it could become a poacher's highway, a threat not only to the snow leopard but also to ibex, brown bear, and the rare and graceful urial, a mountain sheep. One morning near Askole I saw a herd of the latter flowing across a hillside like wind rippling through a field of wheat.

In the weeks that followed, Barbara and Nazir and I visited a number of other remote Balti villages. One of them, the community of Arandu in the lush Basha Valley, would no longer exist had it been located a mere 200 feet higher up. *(Continued on page 549)*

\*See "Tracking the Elusive Snow Leopard," by Rodney Jackson and Darla Hillard, in the June 1986 NATIONAL GEOGRAPHIC.







# War among the peaks

**T**HEY SHOOT at one another across fields of ice. They fall into crevasses or get buried alive by avalanches. They endure intense cold and sometimes fatal altitude sickness. And yet the territory these Pakistani and Indian troops are contesting has little strategic value and is virtually uninhabitable.

Until recently, neither India nor Pakistan showed much interest in Baltistan's icy, eastern corner, a forbidding region known as the third pole because so much of it is covered by glaciers. Both nations claim the area, but its

border has never been clearly defined since the partition of the two nations in 1947.

The shooting started three years ago, when Pakistani and Indian patrols collided on the 18,000-foot-high Siachen Glacier. Both armies soon established camps on or near the glacier, the highest known battleground in history.

Last July I became the first foreign journalist to visit the battle zone. Six years earlier I had skied across the area while it was still pristine territory. At the invitation of Pakistan's President Zia ul-Haq, I rode to the front in an army helicopter, passing in the

shadow of K2 (above left), the world's highest peak after Mount Everest.

At a camp near the Siachen Glacier I was greeted by a sea of empty fuel cans (above). The fuel, needed to fly the helicopters and run the camp, had been carried up the mountainside on the backs of Balti porters. A few miles away at another camp, I found Pakistani soldiers (left) braving sub-zero winds in American-made down-and-nylon suits.

The officer in charge of the camp thrust a cup of tea in my hand as he welcomed me to his fiberglass hut. "We're the



staging camp for the outpost on Conway Saddle, 3,000 feet above us," he said. "We rotate personnel monthly to keep 20 men up there at all times."

"And what do you do here?" I asked.

"Play cards, ride the snowmobile, listen to music, wait for mail. Say, would you shoot a group photo of us?"

While he and his fellow officers posed, a snowmobile pulled into camp with a long bundle wrapped in a sleeping bag. As troops transferred it to a helicopter, I saw a soldier turn away in tears. A friend had died (below right).

"He is our fourth casualty this year at Conway Saddle from high-altitude pulmonary edema," the camp doctor said in frustration. "The only sure cure is rapid descent. We called for a helicopter yesterday, but the weather was poor. We couldn't carry him down till this morning. His lungs kept filling with fluid. He died in the night."

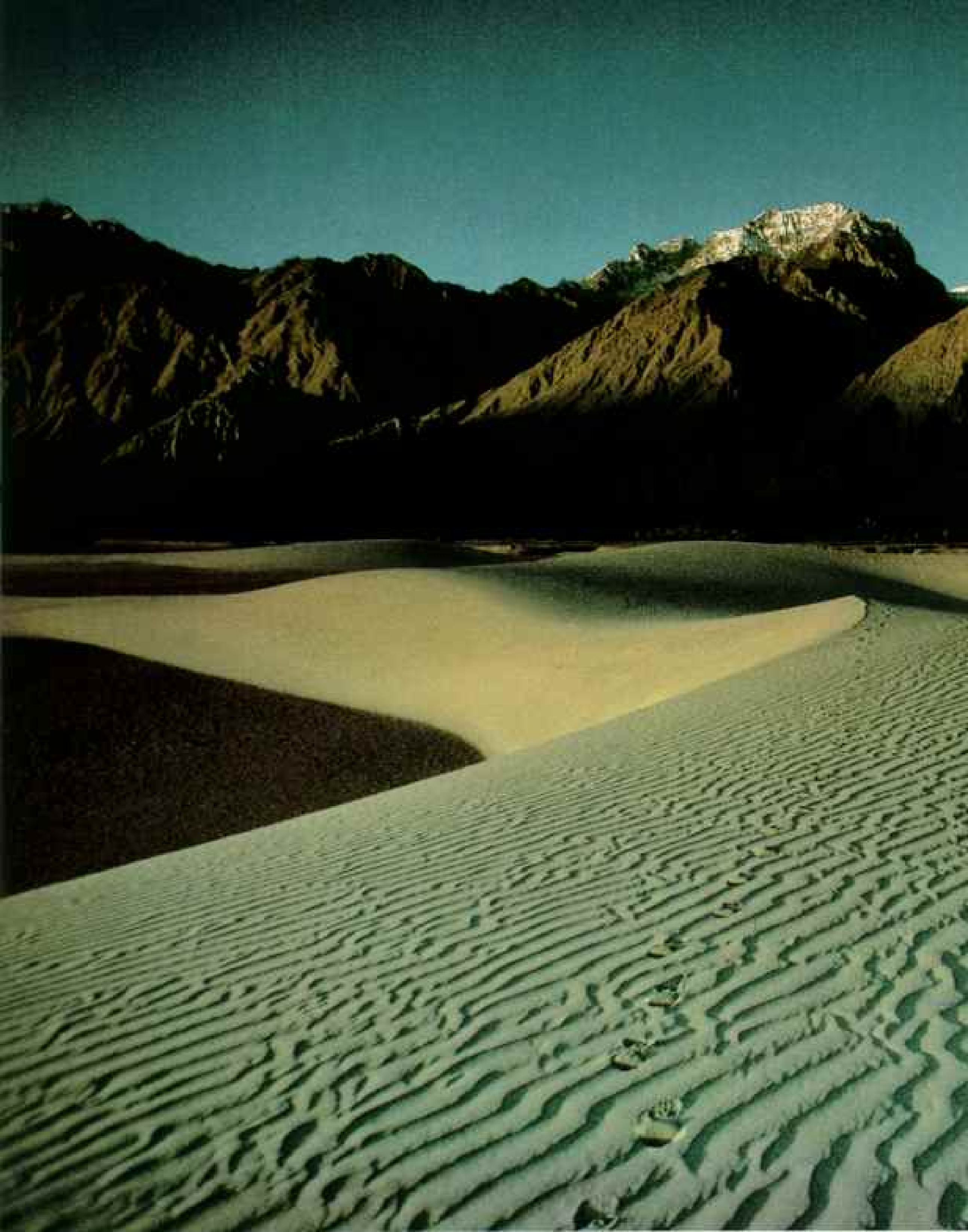
The extreme elevation of Conway Saddle (20,500 feet) tested not only the limits of human endurance but also the capability of the helicopter that tried to take me there. Because of the thin air, we were unable to land safely at the tiny outpost (left). Across a deep chasm, barely two miles away, stood the Indian camp.

Little ground has been won or lost since the fighting began here. Pakistani troops at the staging camp occasionally use a Chinese-made machine gun (above right) to take potshots at aircraft dropping supplies to the Indian high camp. But the view from the helicopter showed me the basic futility of this war. Men might as well fight on the moon as stand on these heights, gasping for breath, with weapons in hand.

—GALEN ROWELL







*Sands of the Karakoram sweep across the broad Skardu Valley. Washed from lofty peaks into the powerful Indus River, the sands are molded by*



BARBARA CUSHMAN NOWELL

*the wind to form rippling dunes. Cut off by mountains from the monsoon rains, the barren soil of Baltistan is a high-altitude desert.*



*The new Shangri-la is a tourist resort outside Skardu. Its flashy centerpiece is a redecorated DC-3, which crash-landed in 1958 and was dragged to its present location. Until 1982 the hull was used as a hunting cabin by Brig. H. Aslam Khan, a hero of the 1947-48 war against India. Now it serves as a honeymoon suite in his new resort, which he named after the imaginary land in James Hilton's 1933 novel, *Lost Horizon*.*

*Two pictures, taken 11 years apart, dramatize the changing pace of life in Skardu. In the first, a lone horseman travels a quiet road beside a barley field in 1975. In the second, a policeman at the same spot directs traffic beneath a canopy of power lines.*







(Continued from page 541) Just above the village a sheer wall of ice towers hundreds of feet high. This is the face of the great Tippuri Glacier, which in earlier years crept north toward Arandu like some vast battleship crossing a rolling sea of fields. After crushing an outlying flour mill, the glacier unaccountably stopped, then retreated to its present position about a hundred yards south of the village.

It may be merely a reprieve for Arandu. Just half a mile to the west lies an even mightier glacier, the 27-mile-long Chogo Lungma, whose inner forces may one day set it on the move toward Arandu.

In the village we were guests of the family of Akbar Ali, who had served as a high-altitude porter on K2 for our American expedition and for a later attempt with Nazir. Shortly afterward, while working for a Japanese expedition, Akbar Ali perished in an avalanche.

Following village custom, Akbar Ali's wife, Ruqiya, married his younger brother. The benefits of such an arrangement were obvious. Ruqiya was able to remain in her home, and her family and in-laws remained together. Ruqiya has three children, one by Akbar Ali and two by her new husband, all with the same grandparents and all living happily under the same roof.

**A**T KHAPALU, a town of 10,000 people below the great peak of Masherbrum, a road from the outside world has already changed traditional patterns of life. The late Raja of Khapalu was a great polo enthusiast who kept a string of ponies and maintained a polo field beneath his three-story palace. Now the field is in disrepair, for reasons explained by a local official.

"Khapalu used to be famous for polo," he told me. "Now there is no good polo because there are no more good horses." He waved glumly at the streets around us. "Everyone today uses jeeps instead."

Change in Khapalu is not confined to land. One afternoon I stopped to watch a herd of goats being transported across the fast-moving Shyok River on a *zakh*, a raft traditionally fashioned of inflated goatskins lashed together. This *zakh* had goatskins at the bow, but inner tubes at the stern.





BARBARA CUSHMAN ROWELL

*A modern woman in a conservative land, Nargis Wazir wonders whether there is still a place for her in Baltistan. Encouraged by her parents, she pursued an education rather than entering into an early, arranged marriage. Now her dreams may carry her away from her homeland, even as it hurries to catch up.*

ON ONE OF MY LAST DAYS in Skardu, as I sipped afternoon tea with some local friends, I recalled an acquaintance of Barbara's and mine, Nargis Wazir, the 27-year-old daughter of a local doctor. Nargis is an attractive high-school teacher who is long past the age when Balti women normally marry. It was obviously a matter of choice, and Barbara once asked her why.

Nargis laughed and said simply, "I have not found anyone suitable. In most Balti families, marriages are still arranged by the parents, but mine gave me the choice and urged me to put education before a husband. That is what I did and I do not regret it, but now that I have finished university there is no one here in Skardu who appeals to me.

The only solution is to leave, and I will go to Islamabad or perhaps an even bigger city. There I shall meet the right man."

Would she come back after she is married, Barbara asked. Nargis shook her head in resignation. "I think not," she said. "When I leave, it will probably be forever."

I thought then of Wazir Ghulam Mahdi, the old farmer Shah Jehan had introduced us to. He had done just the opposite, forsaken the outside world for the simple pleasures and timeless beauty of his country.

With luck Baltistan may change enough to hang onto its bright young people like Nargis, yet retain that Shangri-la quality so beloved by others. It is not an easy balance, and few old-new countries have managed it. One can only wish Baltistan the best. □

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**Snow Leopard** Genus: *Panthera* Species: *uncia*  
Adult size: Length of head and body, 104cm; tail, 89cm Adult weight: Approx. 36—45kg  
Habitat: Mountain ranges in Central Asia Surviving number: Unknown  
Photographed by George B. Schaller



# Wildlife as Canon sees it

One of the greatest roles of photography is to record and preserve images of the world around us worthy to be handed down as a heritage for all generations. A photograph of a snow leopard camouflaged in its natural habitat captures the magnificence of this solitary, elusive, and rarely seen animal.

Well-adapted for hunting in its rugged mountain habitat, the snow leopard has large forepaws, a long tail for balance, and a powerful build for climbing steep, rocky terrain. Due to its extreme rarity, remote and extensive range, and secretive nature, very little is known about the behavior and

ecology of this mysterious cat in the wild. The snow leopard's survival depends on the continued protection of its habitat, an effort that requires the cooperation of all countries sharing this precious natural heritage.

Photography is an invaluable research tool for scientists, and in addition it can help promote a greater understanding and awareness of the importance for man and wildlife to coexist.

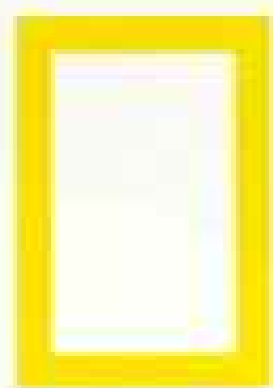
And understanding is perhaps the single most important factor in saving the snow leopard and all wildlife.

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# Canon



## A new world of our own

**T**HANKSGIVING WEEK 1986: John Bonner stands before a hollow fiberglass sphere 11 feet in diameter. He looks to its north and south, then to its east and west. All is blank whiteness. John is assigned to paint the world on it.

When complete, that world will go on display in Explorers Hall at Society headquarters during our 1988 centennial. It will replace one that since 1964 has been a favorite of visiting members and busloads of schoolchildren who continually pass through our doors.

The blank sphere was itself an artful piece of work. It was carefully shaped within a hemispherical mold, with 23 layers of fiberglass cloth and epoxy resin to give it enormous strength and uniform translucence. The latter will make internal light sources clearly visible on the outside surface.

Before light can pinpoint the location of an earthquake, an underwater wreck site, or a region in the news, however, the sphere will become a globe under John's airbrush. As you might expect, hand painting the world's physical features, the ocean floors included, on an 11-foot-wide sphere requires much technical knowledge and an unwavering dedication to accuracy. Less obvious is John's art; his style is as distinctly his own as any landscape painter's.

As a guide to the placement of coastlines and river basins, our cartographers began with 17-foot-long paper plots, or gores, of computerized world map data. Features such as



PHOTOGRAPH BY JOSEPH H. BAILEY, NGS

mountains, valleys, and ocean trenches were painstakingly added. The gores were then photographed, and the resulting 288 slides projected one by one onto the globe's surface and traced as an outline for John to follow.

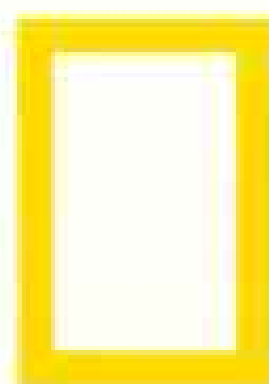
John began in the Northern Hemisphere—more than half the work, since there is more landmass with more intricate features there than in the Southern Hemisphere. As the physical features are completed, layers of clear protective acrylic are applied. Over those will go boundaries and

more layers of acrylic; over those will go place-names and more layers of acrylic. This sandwiching is done so that names and boundaries can be updated without disturbing physical features.

I hope you will be able to visit Explorers Hall after the globe goes on display. And just as a reminder that you will be looking at a work of art as well as of technology: Notice that on every part of that world the sun is always shining from the west, and there is sunlight and shadow even in the ocean depths.

*Silbert H. Brosvens*

PRESIDENT, NATIONAL GEOGRAPHIC SOCIETY



# Members Forum

## Patowmack Canal

As a native northern Virginian and a recent canoeing convert, I echo Mr. Garrett's appreciation for the Patowmack Canal (June 1987). I felt as if I were part of his party on the river. I hope the article will spark a continuous effort to restore this historical landmark. Bird-watchers, photographers, rock-climbers, canoeists, kayakers, and picnickers can all benefit from restoration. Let us not allow priceless endeavors of our past to slip into obscurity.

TERRY K. HOLLOWAY  
*Vienna, Virginia*

The article says that Washington and Richard Henry ("Light-Horse" Harry) Lee had been authorized to form a Potomac navigation company. Mr. Garrett has confused Richard Henry Lee with Henry Lee (Light-Horse Harry). Richard Henry (1732-1794), a signer of the Declaration of Independence, lived in Westmoreland County, Virginia, and is so listed on the shareholders' record on page 728. Light-Horse Harry, best known as the father of Robert E. Lee, was a hero of the Revolution. He was awarded one of Congress's few gold medals for his capture of Paulus Hook in 1779. He became governor of Virginia and later as a member of the House of Representatives gave a funeral oration for Washington that included "first in war, first in peace, and first in the hearts of his countrymen."

BERNARD CARTER BOYKIN  
*Baltimore, Maryland*

*Mr. Garrett, well aware of the distinction, regrets a last-minute change to the text proof that confused the two distinguished Lees.*

James Rumsey is given as inventor of the steamboat. But the date—December 3, 1787—is more than three months later than the one claimed by John Fitch (August 22, 1787). Delegates to the Constitutional Convention were present that day when Fitch steamed up the Delaware.

THOMAS A. McMAHAN  
*Rising Fawn, Georgia*

*We reflected the Shepherdstown view of Rumsey, whose vessel also operated that summer of 1787.*

The article was slightly tarnished by the reference to hunters "blasting ducks out of season and out of sight of game wardens." Those who do

such things are poachers. It is unfair to legitimate hunters to be grouped with such outlaws.

DAVID KAMM  
*Decorah, Iowa*

You did not mention that the boats in the photographs were replicas of those found in Richmond, Virginia, during a building excavation. Work stopped until the boats from pre-Civil War days were removed.

BEV WILLIAM MORANT  
*Sierra Madre, California*

## Tornadoes

Few things have affected me like opening the foldout photo from "Tracking Tornadoes" (June 1987) and realizing that was *our* tornado—the one that missed our house in Cheyenne by a few hundred feet in 1979. The tornado was barreling straight for us; then it turned and slammed into the trailer park instead. Your excellent magazine has continued to amaze me since I received it as a child. But this time you sent a shiver up my spine.

DALE M. LAIDLAW  
*Rainsville, Alabama*

I disagree with Mr. McDonald's statement that houses don't explode and have enough natural openings to keep pressure from building up rapidly. A sudden pressure differential between the inside and outside as small as one pound per square inch can apply 10,000 pounds of force to an eight-by-ten-foot wall and to the few dozen nails that keep the wall up. In 1941 a small tornado in Fillmore, Missouri, passed within 50 yards of my parents' home. We lost most of the windows and my mother's white lace curtains, which were left draped out and over the gutters. My brother's graduation picture was found in a field east of town; the frame with its glass face was still hanging intact in the living room.

MARVIN W. SHORES  
*Pomona, California*

Our June issue arrived just three days before we experienced a tornado. Since our nine-year-old daughter and I had read the article, we understood what was happening and what to watch for. Fortunately damage was minimal. Keep up the good work.

RICHARD WAHLSTRAND  
*Bettendorf, Iowa*

I have written letters to the National Weather Service suggesting that the use of "watch" and "warning" be changed to eliminate confusion caused by the similarity of these words. A tornado watch should continue to mean that tornadoes are expected to develop in a given area. When one is sighted, the word should be "alarm." What better word to say unequivocally "Take cover!"

BETTIE W. CASHION  
*Picayune, Mississippi*



Last year an earthquake at 4:30 a.m. bounced me so hard in bed that I had a very strange dream before I woke up. When I read "Tracking Tornadoes," the drink in my shaking hand was rattling so hard that the ice cubes were chipping. Humans adapt to their environment I guess. I'll take my chances on the Big One earthquake at some unknown future date long before I would live in a place where 850 twisters had a shot at me yearly.

DAVID KOLPACOFF  
*El Cajon, California*

## Gray Whales

I enjoyed your gray whale article (June 1987). I understand that the whale utilizes such areas as San Ignacio Lagoon because of the high salinity. This would make the calves more buoyant as they learn to swim. Can you verify this?

DANIEL J. DAVIDSON  
*Mexico City*

*Salinity is not appreciably higher in the lagoons. The calves' blubber gives them buoyancy.*

Several years ago, on a tourist-boat trip to those Mexican lagoons, I observed that the cows often supported their calves high in the water as if to give them a better vantage to see us. They repeated these maneuvers so close to our skiff that I could stroke the muzzle of a calf with one hand and that of its mother with the other. I know of no parallel situation in which a mother in the wild intentionally presents her offspring to see, be seen, and even touched by an alien species.

KENNETH E. STANLEY  
*Fort Wayne, Indiana*

## Eskimo Tomb

In your June 1987 article I was pleased to see that the Eskimo bodies unearthed by the archaeologists were, after examination, returned to their rest in the earth. I have always felt uneasy seeing the remains of human beings on display in museums or in drawers in the back collecting dust.

ROWLAND R. HILL  
*Norristown, Pennsylvania*

## Laos

Peter White and Seny Norasingh did a good job reporting on the present situation in Laos (June 1987). I wish the GEOGRAPHIC would do the same type of report on Vietnam.

DUC NGUYEN  
*Cypress, California*

As in other Southeast Asian countries, the U. S. is seen as the bad guy. Don't the people of Laos remember Dr. Thomas A. Dooley and the clinics he founded and ran with volunteer help and contributions from the U. S.? He made a significant impact on medical care in Laos.

REBECCA SEARLES  
*Kalamazoo, Michigan*

A wonderful article. My wife and I have had three families and six minors through our home in the past eight years—all from Laos. With other concerned citizens we formed the Barrington Area Refugee Fund, Inc., which resettled nine families last year. We have gained a great deal from our many Lao friends. Mr. White's article is timely because of the desire of many in the Thai government to close the refugee camps.

PHILIP J. BERENT  
*Barrington, Illinois*

## Waterton-Glacier Park

Thanks for the article of June 1987 on the International Peace Park, truly a place to protect and savor. We must steward the buffer zone to maintain the park. I find it ironic and disheartening that several of those most concerned have built retirement homes "just outside the park they love." The settlement of these perimeter areas and the accumulation of homes, people, domestic stock, and pets put that much more pressure on the park.

PAT CLANCEY  
*Kalispell, Montana*

I'm concerned with your mention of the two or three people mauled by bears in most years while neglecting to put this statistic in perspective of the number of annual visitations—more than two million. The probability of a negative experience with a bear for hikers is very low when appropriate precautions are taken.

DENNIS E. JELINSKI  
*Burnaby, British Columbia*

It is still possible to travel to Glacier National Park by train. Amtrak's *Empire Builder*, named in honor of James Hill, founder of the Great Northern, makes daily stops at East Glacier, Essex, and West Glacier on its Chicago-Portland-Seattle run.

RICHARD SCHREINER  
*Miwaukee, Wisconsin*

The Waterton-Glacier article allowed our family to reminisce about our vacation there in 1985. The park ranger on page 820 conducted one of the most enjoyable informative tours of the entire holiday. Her name is Karen Chin. She inspired everyone with her knowledge and enthusiasm—typical of the staff both parks hire.

K. BARRY HEATH  
*Moose Jaw, Saskatchewan*

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*Letters should be addressed to Members Forum, National Geographic Magazine, Box 37448, Washington, D. C. 20013, and should include sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.*

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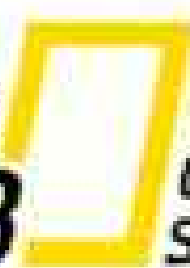
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P E R F O R M A N C E

# On Assignment



**T**HE VEIL OF SECRECY surrounding women in Saudi Arabia provided the challenge of her career, says staff photographer *Jodi Cobb* (above). Among other problems, Jodi had to work around the Saudi custom forbidding women from having their pictures taken. Subjects fled from her camera and passersby interfered. "It was very rare that I could take a picture," Jodi recalls. "I couldn't have done it without the help of some very courageous women."

One key to her coverage was working with author *Marianne Alireza*. Marianne had met a young Saudi, a member of a prominent family, studying in her native California. They married, moved to Arabia in 1945, and started a family before divorcing in 1958. But 13 years in the harem gave Marianne lasting ties to the Saudis—and an insider's view of Arabian women. "It may

not look like much to the 'liberated' Western eye," she says. "But women are doing things now that were unimaginable in my day."

□ **BEHIND** the traffic-stopping nose—a sculpture called "Face Fragment"—the Monell Chemical Senses Center in Philadelphia researches the sense of smell. These data have been augmented by our

Smell Survey, developed by *Dr. Avery N. Gilbert*, left, and *Dr. Charles J. Wysocki*. Avery's graduate work in animal mating introduced him to the role of scent in behavior. Chuck specializes in chemical communication and individual differences in odor perception, as exemplified by sample one on the survey. Chuck could smell it; Avery could not.



MARY McBRIDE (TOP) AND DENIS FINELEY